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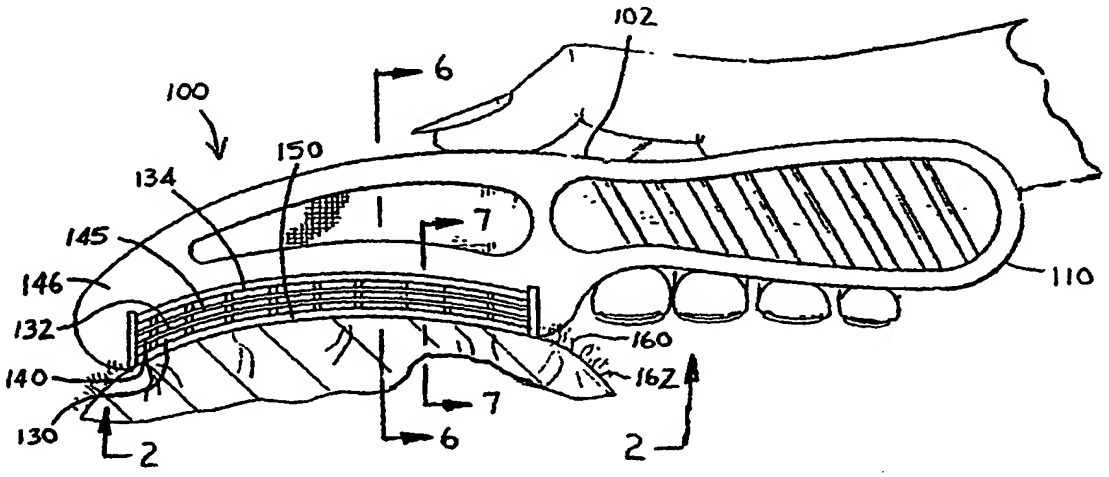

(57) Abstract: The present invention disclosed manually operated, non-electric body shaving devices (100) for shaving substantially curved body portions as legs, arms and underam regions. These shaving devices include a handle (110) and a curved razor blade structure (120) featuring one or two elongated razor blade strips (140, 145) held in a permanently curved configuration. The razor blade structure typically includes a blade support platform (134), flexible razor blade strips, and a blade cap structure (130) that holds the razor blade strips in a permanently curved state. The razor blade structure is preferably longitudinally arranged on the handle, so all major components are located in-line for ease of use. Several embodiments of the body shaving devices having one or more substantially curved razor blade strips are shown and described, including bi-directional and flexible curved razor blade structures and in-line curved cartridge structures.

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BODY SHAVING DEVICES WITH CURVED RAZOR BLADE STRIPS

Field of the Invention

This invention relates in general to curved razor blade strip structures for shaving hair and to manually-operated body shaving devices having substantially curved, longitudinally arranged razor blade strip platforms, and in particular to easy to use lightweight manual body hair shaving devices mounted on handles or on in-line frames having one or more blade strips with curved razor-sharp cutting edges which work in association with blade guards and platforms to provide fast, easy and accurate shaving, preferably in two opposite directions, of large curved body surfaces such as the arms and legs, as well as the underarms.

BACKGROUND OF THE INVENTION

The shaving of curved body portions has always presented certain difficulties. Modern conventional razors are typically made with either one straight blade strip or a pair of parallel straight razor blade strips secured to a razor head structure. The handle typically extends perpendicularly from the razor head structure. The single blade strip or the pair of straight razor blade strips are held in place by a conventional blade platform and cap member. This is the well-known T-bar razor head and handle configuration which has been popular for decades. In the more advanced razor blade systems, such as the Sensor® shaving systems from Gillette, or the Schick Tracer® shaving systems from Warner-Lambert, the blade strips are mounted so as to move during use, to hopefully more closely conform to the contour of the skin being shaved. In the Sensor product, the razor blade strip is mounted to a spring-loaded angled support strip, and so the entire blade strip moves. In the Schick Tracer product, the blade strips flex, since the blade support structure has a flexible configuration. But in both products, the razor blade strips return to their original flat and straight configuration when the user stops applying a shaving force to the razor blade head.

The present day mass-produced devices for the shaving of the legs and arms of women typically employ the same kind of razor head structure. One popular shaver designed for ladies includes wire wrapped blade strips, with several wires spaced from one another extending perpendicularly across the blade strips. These wires serve to help minimize skin nicks. Both this style of razor head and those found in the Gillette Sensor product and the Schick Tracer product are normally provided as a removable

cartridge on a re-usable handle, so that as the razor blade strips become dull, the user can dispose of the worn cartridge and replace it with a new one with pristine sharp blade strips.

While these replacable heads and their straight razor blade strips do adequately shave a woman's arms and legs, this task can consume a fair amount of time. This is because of the areas to be shaved are large, and the straight razor blade strips, which are no longer than 1.5 inches, engage only a small portion of the skin on the curved surface of the leg or arm across which the razor blade head is being moved. Thus, a user must make multiple passes, each one adjacent to and slightly overlapping the next, in order to complete the shaving task. Further, a user who wishes to ensure that all of the hair on the leg or arm being shaved has been effectively cut off may go over the area two or more times. For example, a lady may take the razor and turn it around, so that each given area of the skin is shaved in two directions. As those familiar with manual wet shaving techniques know, this often results in an overall closer and more thorough shaving job.

Using the conventional T-bar razor, the user holds the handle and ordinarily scrapes or moves the head in one direction along the skin so the blade or blades will cut the hair. After each movement in one direction, when the stroke is completed, the user lifts the razor and brings it back to a point near the original starting position for a second stroke in the same direction. Thus, conventional razors are unidirectional in operation and have a straight blade configuration, and typically have a handle arranged in a T-bar configuration.

Those in the field have long realized this, and thus have produced various razor blade shaving devices whose edges are curved so as to be able to cut hair faster. These devices with curved blade configurations have never met with success in the marketplace, to the best of my knowledge. Thus, it is clear that these earlier attempts at providing curved blade razor shaving devices must have certain drawbacks which prevent them from being adopted. I began to consider the problems and limitations associated with using conventional flat razor blade strip designs to shave curved body regions, such as the arms and legs and the underarm areas.

Razors have also been made which have a curved blade configuration. Such curved blade configurations are generally shown in U.S. Patent Nos. 1,008,648; 952,216; and 1,642,338. These patents generally disclose a flexible blade which is secured in a bent configuration to a handle portion by a cap portion. Thereby, the

flexible blade is forced to undertake a curved and rigid formation and provide the end user with a curved shaving razor.

However, this type of razor has several drawbacks. The fixed razor blade forms a convex configuration and thereby further reduces the amount of surface area which may be contacted by the blade on a cylindrical surface such as a leg or an arm. As a result, a user of this type of blade must expend more time in shaving due to the reduced surface area contact per swipe of the razor of the prior invention. Furthermore, these blades must be manually oriented and applied to a surface in such a way as to reduce skin abrasion and increase cutting efficiency. They do not have a cutting plane which inherently orients the blades to the proper configuration. Also, because these designs have a T-handle, they are not bi-directional which allows a user to make a cutting pass on a surface and then reverse direction, thereby pulling the razor in an opposite direction. Instead, with these devices a user must reconfigure the hand position around the handle when reversing direction.

Other razor designs incorporate the use of flexible blade surfaces to conform to a curved surface such as a bumpy face, cylindrical leg, or cylindrical arm. Such designs are generally disclosed in U.S. Patent Nos. 4,516,320; 4,720,917; 4,754,548; and 4,516,320. They generally incorporate a razor blade which is flexible and conforms to a user's shaving surface, such as the face. These blades generally change shape as a result of contour changes in the surface upon which they are pressed. As a result, a user increases the amount of surface area in contact with the blade thereby reducing required shaving time while reducing the likelihood of nicks and cuts.

However, these designs also have some drawbacks. They generally provide a blade that is of a generally straight configuration when not being used. Therefore, the blade only changes shape as a result of being pressed against a contoured surface. As a result, a large amount of force is required to actually bend the blade. Also, the force is distributed across the length of the blade unevenly, causing the center of the blade to encounter the largest amount of force and deflection and the periphery of the blade to encounter the least amount of force and deflection. As a result of this large and uneven force distribution, the quality of the shave may be compromised.

Furthermore, most of these blades are unidirectionally configured. As a result of this, blades are usually located on one side of the razor head. A user must physically rotate the head 180° after making a first pass with the razor to shave with

the razor in an opposite direction. This increases the amount of hand movement required to operate the razor and thereby decreases shaving efficiency.

Thus, there appears to be a continuing need for a simple to use, inexpensive, lightweight curved razor blade device for enabling an individual to easily shave large areas of curved body surfaces, such as arms and legs, with reduced likelihood of accidental cuts or scrapes.

Further, there appears to be a need for a curved body shaving device which has an easily-detached, disposable cutting head or deck, with a substantially permanent reusable handle or fingergrip support structure.

An object of the present invention is to provide one or more razor-sharp cutter portions on a hair shaving device formed from flat flexible elongated razor blade strips held in a permanently curved state so as to make use of a curved razor blade geometry.

Another object is to provide a plurality of curved shaving regions on a curved razor blade device with different degrees of curvature, and different types of curves such as both concave and convex curves, and even continuous compound complex curves, so that a user can adapt the device to optimize his or her shaving actions relative to the targeted curved body portion to be shaved.

Another object of the present invention is to use a thin elongated strip of stainless steel provided with a razor-sharp edge that can be mass-produced with ease as the operative tool in a shaving device featuring a permanently curved razor blade structure that is longitudinally arranged in-line as part of a structure including a handle portion in order to shave large curved body areas such as the arms or legs. A related important object of the invention is to curve or bend the razor blade strip into a permanently curved shape to provide the desired curved geometry from a single elongated strip of metal alloy having at least one razor sharp edge. A further related object is to provide a cutter head structure that employs a curved elongated razor blade strip within a guard structure that can be easily cleaned to facilitate its reuse.

Yet another object is to provide an easily cleaned curved razor blade strip structure that has razor-sharp blade edges on both sides of the structure mounted in an in-line structure with a handle portion to facilitate easy and rapid shaving action in two opposite directions without forcing the user to change his or her grip on the handle of the shaving device.

Another object is to provide a guarded curved blade body shaving device in a

structure with a handle portion, preferably in an in-line configuration, so that it is inherently easy to operate, such that, with a minimum of practice, a user need not even bother to look closely at the device as during shaving use.

Another object of this invention is to provide a razor-sharp curved body shaving device, preferably constructed using a cartridge-style curved razor blade strip shaving structure, with components that are inexpensively manufactured on a mass-production basis, and then readily assembled into a precision shaving device having elongated razor blade strips mounted in a permanently curved configuration.

Yet another object is to provide a permanently curved razor blade strip shaving structure or head, in both handle-mounted and cartridge-mounted configurations, that features floating curved blade strips, so as to help maximize close shaving action.

Still one more object is to provide an in-line curved blade hair shaving device which has a manually removable and replaceable plastic safety cover which fits over the shaving head for encasing the sharp edge, and is frictionally held in place upon the shaving device structure, so that the device can be stored and transported safely.

SUMMARY OF THE INVENTION

In order to fulfill the most if not all of the needs and objects above-stated, there is provided according to a first few embodiments of the present invention, a curved blade shaving device for shaving hair from curved body surfaces comprising a structure having a base support portion and a handle portion; and a cartridge structure operable for being releasably attached to said base support portion and operable for being deflected in response to body surface contours, said cartridge structure comprising (a) at least one blade strip disposed in communication with said blade support platform, each blade strip having at least one sharpened edge; (b) a front guard surface disposed in a spaced proximity from each sharpened edge; and (c) a rear guard surface disposed in a spaced proximity from each sharpened edge; wherein a working plane for shaving with said at least one sharpened edge is established through the cooperation of said front and said rear guard surfaces; wherein said curved-blade shaving device is operable for shaving upon tilting said blade support platform in a first direction to bring said working plane into at least tangential contact with a skin surface and moving said curved-blade shaving device across said skin surface in said first direction.

Other objects, features, operating principles, and advantages of the shaving devices of the present invention will become apparent upon studying the various Figures in the drawings and reading the following detailed description and subjoined claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, where the same reference numerals reference like items or features in the different views:

Figures 1 through 9 illustrate a first embodiment of the body shaving device of the present invention, which includes a structure having a handle portion, a curved base support portion, and a curved razor blade platform structure mounted in the base structure and including two spaced-apart razor blade strips which are parallel to one another and follow the curvature of the razor blade support structure, with each blade strip having opposed elongated razor blade edges for bidirectional shaving of legs, arms or like curved body areas, where:

Figure 1 is a side elevational view of the body shaving device held in a user?s hand and shown set down transversely upon a curved body member, namely, a leg (shown in partial cross-section);

Figure 2 is a bottom view of the Figure 1 device showing the contour of the handle and the two sets of opposed blade edges with a central cap member covered by a (speckled) lubricant strip therebetween;

Figure 3 is a view of a woman using the Figure 1 body shaver to shave hair from an upper calf portion of her left leg (with the body shaving device shown somewhat larger than its preferred size, for clarity of illustration);

Figures 4 and 5 are a side elevational view and a cross-sectional view (taken along line 5-5) respectively, of a lightweight plastic storage cover having a generally cylindrical cross-section as best shown in Figure 5, with a cross-hatched central gripping portion to enable a user to remove the cover from the razor blade strip structure of the body shaving device, which the cover fits over;

Figures 6 and 7 are transverse fragmentary cross-sectional views of the Figure 1 device taken along lines 6-6 and 7-7 respectively of Figure 1, which help illustrate a preferred internal construction of the base support portion and the razor blade platform structure mounted therein, and the flow-through spaces provided between the parallel razor blade strips at regular intervals, as best seen in Figure 7;

Figure 8 illustrates two cross-sectional views of the type shown in Figure 6 for the purpose of illustrating the shaving action in two opposite directions which can be achieved along a curved area of the body, such as the thigh, which is depicted in longitudinal cross-section;

Figure 9 is an enlarged, fragmentary, exploded side elevational view of the curved base support portion and flexible razor blade strip platform structure of the Figure 1 body shaving device, which shows from bottom to top -- the lubricant strip, plastic pins, interconnected flexible cover member, first razor blade strip, five blade spacers, second razor blade strip, and flexible platform member, all of which form the curved razor strip platform structure, which is held by the pin-like projections of the platform structure once inserted into corresponding tapered locking holes in the base support portion.

Figure 10 illustrates a second embodiment of the elongated longitudinally curved concave body shaving device of the present invention, and is an enlarged fragmentary exploded side elevational view of a second embodiment of the curved base support portion and a rigid cartridge-style curved razor blade strip platform structure, much like the Figure 1 body shaving device in appearance, which cartridge includes from bottom to top -- lubricant strip, interconnected flexible cover member with five integrally formed pin members, first razor blade strip, five flat, generally rectangular blade spacers, second razor blade strip, and substantially rigid plastic platform member, all of which form the cartridge structure, which is held in the base support portion by a plurality of detents formed of wedges and slots, once inserted into the corresponding elongated generally rectangular trough of the base support portion.

Figure 11 is an enlarged fragmentary transverse cross-sectional view of one wedge and slot taken along line 11-11 of Figure 10, which helps illustrate how the platform member is removably locked into the rectangular trough of the base support member.

Figure 12 is a side-elevational view of a third embodiment of my longitudinally arranged in-line body shaving device which has a first concave razor blade platform structure similar to that shown in the first embodiment above (i.e., Figure 1), but with a different complex concave curvature, and a second convex razor blade platform structure on the distal end of the handle portion of the device, which is suitable for shaving concave body regions such as the underarm areas, whose razor blade platform structure may be similarly formed, and further Figure 12 shows in phantom

two transparent plastic safety covers for the two blade structures;

Figure 13 shows a fourth embodiment of my longitudinally arranged body shaving device which has a complex compound razor blade platform structure having three regions of different curvature, while the blade strips are centrally located in a common longitudinal plane, with the three regions being: a distal convexly curved razor blade strip region suitable for shaving underarm areas, a larger intermediate concavely curved razor blade portion suitable for shaving more rapidly curving body areas such as are found on the lower arms and legs, and a proximal razor blade portion which has a very slight concave profile, suitable for shaving gently curving body regions such as the thighs.

Figure 14 illustrates that the Figure 13 body shaving device may be provided with two removable generally hollow plastic razor blade safety covers respectively shielding the razor sharp edges of the blade strips in the distal region and in the intermediate and proximal regions of the Figure 13 device, when those regions are not in use, and Figure 14 also shows a lightweight flexible polyethylene travel case or pouch into which the Figure 13 device with covers installed thereon may be placed, and secured via a conventional snap adjacent the handle, as shown.

Figures 15 through 17 illustrate a fifth embodiment of my longitudinally arranged body shaving device, where:

Figure 15 is a side elevational view of the fifth embodiment, with the device being shown generally in outline form, and illustrating the complex compound curved double-edged razor blade structure thereof, which has a pair of continuous razor blade strips, forming three interconnected regions, namely, a gently curving convex region beginning adjacent the handle, a rapidly curving convex region at the distal end of the device, and a concavely curved region opposite the gently curved convex region which terminates at the handle, which device is suitable for shaving virtually all large contoured or curving areas of the human body; and

Figure 16 is an enlarged transverse cross-sectional view taken along lines 16-16 of Figure 15, which shows the two razor blade strips spaced parallel to one another and held upon a base platform member by a cap member with integral pin, and Figure 17 illustrates that a curved region may be made to be substantially straight for short distances if desired.

Figure 18 is a side elevational view of a sixth embodiment of the longitudinally arranged body shaver of the present invention, which features a concave blade strip

platform and a fingergrip portion opposite the blade strip platform, which fingergrip region is provided with a raised rim and wavy raised lines for improved finger gripping.

Figure 19 is a seventh embodiment of the body shaving device of the present invention shown in side elevation which has a convexly curved blade strip platform suitable for shaving underarm areas, and a handle with a raised rim along its perimeter and opposite the blade strip platform and a textured region within the rim perimeter provided with cross-hatching for improved finger gripping.

Figure 20 shows an eighth embodiment of the longitudinally arranged body shaving device of the present invention which is essentially a combination of the sixth and seventh embodiments, since it has a concave blade strip platform and a convex blade strip platform, which is provided with two substantially hollow transparent clip-on plastic covers, shown removed from the device with arrows pointing to the cover locations illustrated in phantom.

Figures 21-23 illustrate a ninth embodiment of the present invention, which is like the second embodiment shown in Figures 10 and 11 (and therefore its identical razor blade cartridge structure is not shown), but which includes a thinner handle section having a different textured pattern, where:

Figure 21 shows the device in a side elevational view, without a shaving cartridge, but with the cartridge support base installed therein;

Figure 22 is a side perspective view of the Figure 21 device, with the cartridge support base pulled out to reveal the detent arrangement; and

Figure 23 is an enlarged transverse cross-sectional view of the device shown in Figure 22, taken along lines 23-23, to show the wedge and groove portions of the support base and handle channel respectively that form a detent arrangement for removably connecting the cartridge support base to the corresponding socket in the front section of the handle.

Figures 24 through 27 illustrate a tenth embodiment of the longitudinally arranged cartridge-style curved shaving device of the present invention, which employs two sets of parallel razor blade strips movably mounted upon springs for a limited amount of controlled deflection within the blade support platform, where:

Figure 24 shows a cross-sectional view, as would be seen if the cross-section of the tenth embodiment were taken along line 23-23 of Figure 22, showing the handle frame, the canoe-shaped cartridge support base or platform, the razor blade strip platform with its spring loaded fingers, and its four blade strips held thereon by

retaining pins, and its cap member interlocked by retaining pins to the blade platform;

Figure 25 is a partial fragmentary side elevational view of a single blade of Figure 24, showing a single curved blade strip in an "at rest" state and in a partially depressed state by a force indicated by arrow 26 in Figure 26; and

Figure 27 is a perspective view of one possible curved arrangement of a single razor blade strip of the tenth embodiment, and showing its construction from a flexible razor blade strip having a sharpened edge joined by laser welding to a L-shaped elongated blade support member.

Figures 28 through 30 illustrate an eleventh embodiment of the curved shaving device of the present invention, which is a cartridge-style curved shaving structure, which includes a flexible platform guide structure, flexible platform structure, two flexible blades separated by spacers, and a flexible cap member, all fastened together by press-fit metal retaining pins as shown, where:

Figure 28 is an exploded side elevational view of the foregoing components, with dashed lines indicating the path of the two end retaining pins through the cap member, platform guide member and platform leaf spring strip; and

Figures 29 and 30 are transverse cross-sectional views taken along line 29-29 and 30-30 of Figure 28, showing the cartridge-style curved razor blade structure in an assembled state.

Figure 31 is an exploded side elevational view of another configuration of the cartridge-style curved razor blade structure, with dashed lines indicating the path of the two end retaining pins through the cap member, platform guide member and platform leaf spring strip, wherein a single flexible platform is employed.

Figure 32 shows in partial perspective view of the shaving device of the ninth embodiment of the present invention being used by a woman to shave her left leg in two directions, the right direction indicated by arrow 32R being shown in solid, and the opposite or left direction indicated by arrow 32L being shown in phantom, to illustrate the ability of the user of the shaving device to conform its curved shaving regions to her leg, and to move the shaving device in right and left directions easily along her leg without changing her grip.

Figure 32A shows in perspective and phantom views available positions for the shaving device of the ninth embodiment of the present invention to expose three different sections of the razor blade structure of the device relative to a cross-section of a leg.

Figure 33 illustrates one preferred hand grip of such user upon the handle of the shaving device, which provides good, sure grip and a good tactile response.

Figure 34 shows in a simplified side perspective view the twelfth embodiment of the shaving device of the present invention, which has an alternative handle of rectangular cross-section, as shown in Figures 35-37.

Figures 35 through 37 illustrate that the handle of the shaving device of the twelfth embodiment may be readily gripped in three different orientations, each of which will provide a user with the ability to easily perform the back and forth shaving motion as illustrated in Figure 32 by simply moving the forearm and twisting the wrist by roughly a quarter turn without needing to change his or her grip on the handle during the shaving strokes in opposite directions over the same curved skin area on a leg or arm.

Figure 38 is a set of five curves, shown above the cartridge support base of Figure 28, which illustrate how the flexible curved blade structures of the present invention are held in a curved "at rest" state represented by the solid line in curve sets A through E, and how the flexible razor blade strip structures of the tenth and eleventh embodiments of the present invention can assume the positions shown by the dashed lines in curve sets A through C, and how the independently-sprung blade strip support arrangement of the eleventh embodiment can also allow the razor blade strips to bend in more complex curved patterns from the at-rest curved state, as exemplified by the dashed lines in curve sets D and E.

Figure 39 shows another configuration for the curved blade shaving device of the present invention, having a curved section integrally formed with a more gently curved, or almost straight, section.

Figures 40-42 show the utility of the configuration of curved blade shaving device shown in Figure 39, for enhancing the shaving of both sharply curved body surfaces and adjacent gently curved body surfaces, where:

Figure 40 shows use of the configuration of the Figure 39 device upon a calf;

Figure 41 shows use of the configuration of the Figure 39 device upon an ankle; and

Figure 42 shows use of the configuration of the Figure 39 device upon an thigh.

Figures 43 and 44 show another embodiment of curved blade shaving device of the present invention, wherein a thin wire is wrapped around the blade elements of a cartridge structure for reducing the likelihood of nicks and cuts, wherein:

Figure 43 is a top view of a cartridge structure suitable for any embodiment of the present invention, having a thin wire wrapped around the blade elements thereof;

Figure 44 is a perspective view of the cartridge structure of Figure 43; and

Figure 45 shows another configuration for the curved blade shaving device of the present invention, having a curved section disposed adjacent to a more gently curved, or almost straight, section upon a base support portion.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Several different hair trimming devices of the present invention which employ one or more curved razor-sharp blade strips are shown in the Figures and discussed herein. While these embodiments are presently preferred, they are still only exemplary of the various possible curved razor blade strip hair shaving structures and devices of the present invention. As explained further below, I contemplate that, within the scope of the present invention, variants of the curved blade shaving devices of my present invention may readily be constructed based upon my teachings herein.

Several different hair shaving devices of the present invention which employ one or more curved razor-sharp blade strips are shown in the Figures and discussed herein. While these embodiments are presently preferred, they are still only exemplary of the various possible curved razor blade strip hair shaving structures and devices of the present invention. As explained further below, I contemplate that, within the scope of the present invention, variants of the curved blade shaving devices of my present invention may readily be constructed based upon my teachings herein.

While the foregoing embodiments have been described above particularly with respect to certain curved body portions, those skilled in the art should appreciate that the broader aspects of the present invention are by no means limited to shaving hair from the mentioned body portions. Instead, the present invention of a razor sharp curved blade structure with suitable front and rear blade guards to form a safe working platform can be applied to shave any areas of the body upon which hair grows, including the head, behind the knees, or on the top of the foot, or even the fingers. In order to implement such as structures, the embodiments described above may be changed in size, either reduced or enlarged, and can be provided with different curves of convex or concave proportions matching those typically found in the aforementioned curved hairy parts of the human anatomy. Also, to better shave human legs or arms, which are often shaved either for health reasons (such as during surgery) or for cosmetic or beauty reasons, the curved portions of the curved razor blade strip structures can be more closely sculpted to conform to typical curves found in these or other areas of the human anatomy for a selected population group (e.g., adult males, adult females) to be cleanly shaved.

Further, although the foregoing embodiments are discussed as being for use by one's self in shaving one's own legs or arms, those in the art will appreciate that barbers, health care professionals, geriatric attendants and other care-givers may

safely use the curved body shaving devices of the present invention to safely cut hair of others, such as their customers and/or patients. In addition, although the foregoing embodiments are discussed with respect to shaving the legs and/or underarms of humans, those skilled in the art will appreciate that those same devices may also be used for trimming hair on curved body surfaces of animals (such as may be necessary during surgery to remove hair growing on areas of curved skin to be operated on, and thus which need to be clean-shaven before surgery.

Thus, those skilled in the field will appreciate that the embodiments of the curved razor blade strip shaving devices of the present invention illustrated and discussed herein are subject to modification and change without departing from the scope of the invention as recited in the claims below. Needless to say, the overall size, proportion, materials, weight and clearances of the various components used in the razor-holding portions, the front and rear portions of the handles, and connection mechanisms for attaching the curved razor blade strip structure to the handles of the shaving devices of the present invention can be varied as needed or desired.

Lastly, while the embodiments herein have been described in connection with particular examples, it will be appreciated that any combination of any of the features of these embodiments may be used interchangeably among the various embodiments to produce curved razor blade shaving devices having the desired configuration and/or structure. Thus, it is to be understood that the present invention is by no means limited to the particular constructions herein disclosed and/or shown in the drawings. Instead, the present invention also encompasses any modifications or equivalents within the scope of the disclosures that are fairly covered by the claims set forth below.

My shaving device can be implemented as a structure that is symmetrical or asymmetrical about an imaginary central longitudinal axis which divides the forward blade-supporting portion and handle portion from one another. Unless otherwise indicated, they are also symmetrical about the central plane of the overall device, in which the central longitudinal axis is found. Thus, those in the art should appreciate that the descriptions herein of one side, end, or section of any given cutting head or handle will also serve to describe the other half of said symmetrical structure on the opposite side of the central imaginary axis or central longitudinal plane.

The handle portion of the shaving device may be made of a molded plastic material or of a metal stamping or casting. Thus, a system is contemplated where blade cartridges are removable from and replaceable upon a reusable structure

including a handle portion. The body structure of the device is divided into a head portion and an integral handle portion. The overall length of the device is sized for convenient shaving of curved body areas, such as the arms or legs, and can be adjusted as desired. Also, the curvature of any curved blade portion of any shaving device embodiment described herein can be adjusted as desired to match the curvature of any body surface to be shaved. In addition, the handle portion is preferably axially aligned with the head portion.

With the cover, which can be cap-like or sleeve-like, which cover can be used with any of the described devices, a convenient shaving system is provided which is sanitary, safe, easily usable and sufficiently inexpensive that it may be discarded after a limited number of uses.

Figures 1-9 show a first preferred embodiment of a curved hair razor blade device 100 of the present invention. Specifically, Figures 1 and 2 show a side view and a bottom view, respectively, of a curved hair razor blade device 100, including a structure 102. The handle portion 110 and the base support portion 146 constitute the structure 102, which is the primary support mechanism for the curved hair razor blade device 100 as a whole. Accordingly, the handle portion 110 and the base support portion 146 are preferably formed as a single, continuous piece of molded plastic. Alternatively, the handle portion 110 and the base support portion 146 may be of a detachable or folding nature, and may be made from any suitable material, including metal such as stainless steel, and may be hollowed out in various areas to reduce weight. It can even be formed from a hollow metal or plastic tubular frame formed into the desired handle shape.

The curved hair razor blade device 100 preferably includes a double-bladed razor blade cartridge structure 120 for shaving, shown in Figures 1, 2 and 6-9. It will be appreciated, however, that a single-blade structure or a triple-blade structure may also be suitable. The cartridge structure 120 is intended to be constructed from flexible materials including one or more very thin, elongated flexible metal blade strip members. As such, the structure 120 is intended to be initially configured in a flat geometry, and is subsequently bent to a curved configuration to suit the particular mounting need. A blade support platform 134 is attached directly to the base support portion 146, which is the front half section of the handle portion 110. A curved blade strip 145, spacers 132, a second curved blade strip 140 and a blade cap structure 130 are each stacked, sequentially in order, upon the blade support platform 134. Locking

pins 131, whose heads rest upon the blade cap structure 130, operate to secure the blade cap structure 130, the curved blade strips 140 and 145 and the spacers 132 to the blade support platform 134. A conventional shaving lubricant strip 150 may be secured upon the blade cap structure 130 for lubricating the skin during use. The lubricant strip 150 is typically constructed of a depletable water-soluble lubricating substance that gradually wears away with use. As shown in Figures 1 and 8, the curved hair razor blade device 100 is used upon a skin surface 162 for the cutting of hairs 160 from that surface. It will be appreciated that the various components of the cutting structure previously described are curved to a degree advantageous for shaving curved hairy surfaces of the body. Accordingly, it will be appreciated that the level of curvature may be adjusted for any suitable curved need.

One variation for the curved hair razor blade device 100 is to have one or more blades, each having only a single sharpened edge located on the same side of the device 100, so that shaving may be performed in one direction only. Preferably, however, the curved hair razor blade device 100 is constructed, to have opposing sharpened edges and be a bi-directional cutting device as shown and as will be further explained. Figure 7 shows that the curved hair razor blade device 100 is constructed to include two working planes 170 and 180 for shaving. These working planes are established through the cooperation of two surfaces in close proximity, but spaced apart from, the blade edge to form a plane. The surface or surfaces in close proximity thus act as a single guard member, or front and rear guard members, to a sharpened blade edge. The working planes may be formed through the cooperation of the edges or other surfaces of the blade support platform 134 and the edges of the blade cap structure 130 or a lubricant strip 150 disposed thereupon. Preferably, the working planes are established by configuring the curved hair razor blade device 100 in a symmetrical fashion to establish two working planes offset by an angle at which the device can be repetitively tilted back and forth to accomplish bi-directional shaving. The working planes 170 and 180 have been designed to shave hairs when either of the working planes 170 or 180 is moved across a skin surface in a substantially parallel manner. As shown in Figure 8, manual tilting of the curved hair razor blade device 100 at angles suitable for bringing the working planes 170 or 180 into contact with the skin, allows the curved hair razor blade device 100 to perform bi-directional shaving upon movement of the device in the direction of the tilt of the device. Thus, as shown in Figure 8, a back-and-forth shaving exercise can be accomplished using this device by

alternatively tilting the curved hair razor blade device 100 in alternate directions and moving the device in that direction along the skin surface. Accordingly, the components of the cartridge structure 120 that form the working planes 170 and 180, namely, the lubricant strip 150, the blade cap structure 130, the curved blade strips 140 and 145 and the blade support platform 134 are all constructed in a symmetrical configuration relative to a plane of symmetry of the device, and are of increasing width from the exterior to the interior components, to form the working planes 170 and 180 as shown. In the arrangement where a single sharpened blade edge is used, the sharpened blade edge cooperates with one or more of the above surfaces along the same side of the device as the sharpened edge. It will be appreciated that these principles of construction for the curved hair razor blade device 100 may extend to all embodiments described herein.

Figure 7 also shows a particular feature of the blade support platform 134, where flow-through spaces 135 are included at regular intervals. These flow-through spaces 135 provide a location for hairs that are cut during the shaving process to accumulate away from the locations of the blade edges. Figures 4 and 5 show a storage cover 190 having a substantially cylindrical cross-section and including a projecting gripping portion 195 for facilitating placement and removal of the storage cover 190. The storage cover 190 may preferably be made of a transparent plastic, although it will be appreciated that any other suitable material may be used.

Figure 3 shows the use of the curved hair razor blade device 100 upon a skin surface 162, such as a human leg. Tilting the razor blade device 100, as shown in Figure 8, and manually moving the device 100 across the skin surface 162 in a back-and-forth motion allows a skin surface 162 to be cleanly shaven.

Figure 9 illustrates an exploded view of the components of the curved hair razor blade device 100. This figure also shows that the cutting structure can be constructed as a removable cartridge structure 120, which can be removed for cleaning or replacement as desired. In this regard, the placement of the curved blade strip 145, spacers 132, the curved blade strip 140 and the blade cap structure 130 together can be locked in place through the use of multiple locking pins 131. The locking pins 131 are preferably insertable within recesses 133 of the blade cap structure 130, pass through the blade strips 140 and 145 and spacers 132, and are receivable within apertures 138 of the blade support platform 134. It will be appreciated, however, that other suitable engagement mechanisms can be employed

for the cartridge structure 120. In addition, a lubricant strip 150 may preferably be located upon the surface formed by the blade cap structure 130 and the recessed heads of the locking pins 131. The entire cartridge structure 120 can then be secured in place upon the base support portion 146 by fitting the components of the cartridge structure 120 into a rectangular-shaped trough 147 of the base support portion 146 and engaging the projections 148 of the blade support platform 134 with the apertures 149 located within the base support portion 146. It will be appreciated that any alternative securing arrangements, including the use of alternative fixation devices, may also be used.

With regard to Figures 10 and 11, another embodiment of the curved hair razor blade device of the present invention is shown generally at 200. The razor blade device 200 includes a structure 202 having a base support portion 246 that is preferably integrally formed with a handle portion (not shown) of the type previously described. This embodiment shows a slightly different configuration for the cartridge structure 220 that is removably attachable to the base support portion 246. Specifically, the cartridge structure 220 includes a blade cap structure 230 which includes integrally formed locking pins 231 as a substitute for the separately formed locking pins 131 which engaged the blade cap structure 130 in the previous embodiment. In similar manner as the locking pins 131, the locking pins 231 are engaged with the blade cap structure 230 so as to provide a surface for receiving a lubricant strip 250. Disposed upon the blade cap structure 230 are the blade strip 240, spacers 232, and blade strip 245. These components fit upon the locking pins 231, which is bent to a curved configuration and mated with the blade support platform 234, so that the locking pins 231 are received within apertures 238 of the blade support platform 234. This assembly completes the cartridge structure 220. The cartridge structure 220 is then removably disposed within a rectangular-shaped trough 247 of the base support portion 246 and is retained in place through the engagement of rectangular-shaped wedges 236 with rectangular-shaped slots 237 disposed upon the base support portion 246. As shown in Figure 11, the engagement of the wedges 236 and slots 237 allows the cartridge structure 220 to be snap-fit into place within the trough 247, and subsequently removed by pulling the cartridge structure 220 away from the base support portion 246 with sufficient force to overcome the engagement between the wedges 236 and the slots 237. It will be recognized, however, that any suitable engagement mechanism may be utilized for these components. The concave

curvature of the cartridge structure 220 in this embodiment is especially useful for shaving convex skin surfaces of the body, such as the legs.

Figure 12 shows another embodiment of the curved hair razor blade device of the present invention, generally at 300. The razor blade device 300 includes a structure 302 having a handle portion 310 and a base support portion 346 in similar manner as before. In this embodiment, however, the razor blade device 300 includes two differently shaped cartridge structures for facilitating shaving upon differently contoured body surfaces. Accordingly, the razor blade device 300 includes a first cartridge structure 320, which is of a generally concave curvature, in similar manner as the previous embodiment. Additionally, the razor blade device 300 includes a second cartridge structure 320', located upon the distal end of the base support portion 346. The second cartridge structure 320' is of a convex curvature, and is suitable for shaving concave body regions such as the underarm areas. Thus, the razor blade device 300 provides both concave and convex shaving surfaces for the shaving of convex and concave body surfaces, respectively, in a single device.

The construction of the cartridge structures 320 and 320' are similar to the structures described in connection with Figure 1. The first cartridge structure 320 and the second cartridge structure 320' are shown to include, respectively, from exterior to interior surfaces, lubricant strips 350 and 350', blade cap structures 330 and 330', blade strips 340 and 340', spacers 332 and 332', blade strips 345 and 345' and blade support platforms 334 and 334 . It will be appreciated that these structures may be varied according to any of the embodiments describe removable and replaceable in substantially the same way as previously described. The razor blade device 300 also includes covers 390 and 390', which may preferably be made of a transparent plastic material or any other suitable material. The covers 390 and 390' are intended to be separately removable from the cartridge structures 320 and 320', so as to expose one or both cartridge structures as may be desired for shaving or storage.

Another embodiment of razor blade device is shown at 400 in Figure 13. As before, this razor blade device 400 includes a structure 402 having a handle portion 410 and a base support portion 446. As before, this razor blade device 400 includes a handle portion 410 and a base support portion 446. In this embodiment, however, a cartridge structure 420 is provided in a continuous complex curvature of three distinct regions, namely, a distal convexly curved razor blade strip region suitable for shaving underarm areas, a larger intermediate concavely curved razor blade portion suitable

for shaving more rapidly curving body areas such as are found on the lower arms and legs, and a proximal razor blade portion which has a very slight concave profile, suitable for shaving gently curving body regions such as the thighs. These three regions are formed in this embodiment from a single continuous cartridge structure 420, which is suitably flexible for establishing these shapes. In a similar manner as before, the cartridge structure 420 includes, from exterior to interior surfaces, a lubricant strip 450, a blade cap structure 430, a blade strip 440, spacers 432, blade strip 445 and blade support platform 434. The structure of this embodiment may preferably be substantially similar to any of the structures shown in Figures 1-11.

Figure 14 illustrates the use of suitable covers for the sections of the cartridge structure 420. In this figure, blade covers 490 and 491 are provided, which are suitable for shielding the cartridge structure 420 in two sections, divided at the outermost portion of the convexly curved razor blade portion. Accordingly, the blade cover 490 is suitable for shielding the distal convexly curved razor blade strip region. The blade cover 491 is operable for shielding the proximal portion of the convexly curved razor blade strip region, the intermediate concavely curved razor blade portion and the proximal concave razor blade portion. In addition, the curved hair razor blade device 400 may also be provided with a pouch 492 for carrying the entire distal portion of the razor blade device 400. The blade covers 490 and 491 may be attached or removed as desired to expose one or both sections of the cartridge structure 420 for shaving purposes. Other suitable configurations for the covers may also be used.

Figures 15 and 16 show one such embodiment of a curved hair razor blade device 500 of the present invention. These figures show in a side elevation and a cross-section respectively, a blade support platform 534 supporting a plurality of curved blade strips 540, 545 or elongated blade strips having razor sharp edges, and suitable spacers 532 between the platform and blade strips 540, 545, and a blade cap structure 530 with locking pins 531 for interlocking the curved blade strips 540, 545 to the blade support platform 532. In a preferred construction of this embodiment of the shaving device of the present invention, the razor sharp blade strips 540, 545 are formed from continuous lengths of metal which extend substantially along the entire continuous curve surfaces as shown in Figure 15. In particular, those skilled in the art will appreciate that Figure 15 includes the following portions: a convex portion 516, a concave portion 520, and a substantially circular arc portion 524. In Figure 17, the curved portion A of the embodiment shown in Figure 15 is shown in phantom lines,

while the solid lines illustrate a substantially flat portion for shaving those hairy skin surfaces of the body which are substantially planar in nature, such as certain portions of the skin area directly adjacent the flat portions of the shin bone on the typical human leg. Although shown in Figure 17 with only a single straight portion of limited length, those skilled in the art will appreciate that additional substantially straight portions of the continuous blade may be provided. This "french curve" structure of the present invention also includes a handle portion 510, which may take any suitable form, such as the elongated hand-grip style shown in Figure 15, or any other suitable grip, including fingertip grips, flat grips and an arcuate hand grip having a passage or holes therethrough for receiving the fingers. The blades 540, 545 may also be of a segmented form.

Figure 18 shows yet another embodiment of the curved hair razor blade device of the present invention, generally at 600. This razor blade device is of a more unitary structure than those devices shown in previous embodiments. The razor blade device 600 also includes a structure 602 having a base support portion 646 with an integrated fingergrip portion 610 having a generally corrugated surface. A cartridge structure 620 is preferably of similar configuration as those cartridge structures previously described, and is mounted in a generally concave configuration upon a side of the base support portion 646.

An alternative construction of curved hair razor blade device is shown in Figure 19 at 700. In this embodiment, the razor blade device 700 also includes a structure 702 having a base support portion 746 with an integrated fingergrip portion 710 having a textured cross-hatched surface for improved finger gripping. A cartridge structure 720 is also located upon the base support portion 746, although in this embodiment, the cartridge structure 720 is of a generally convex configuration and is disposed along an upper end of the base support portion 746, as opposed to along the side of the base support portion 646 in Figure 18. Thus, while the razor blade device 600 in Figure 18 is most useful for trimming convex surfaces such as the thighs, the razor blade device 700 in Figure 19 is most useful for shaving concave body surfaces such as underarm areas. It will be appreciated that the cartridge structure 720 may preferably be substantially similar to the configuration of the cartridge structures previously described.

With regard to Figure 20, yet another embodiment of the razor blade device of the present invention is shown generally at 800. The razor blade device 800 includes

a structure 802 having a base support portion 846 with a finger grip portion 810 integrated thereupon. The finger grip portion 810 is shown to have a textured surface as before, although it will be appreciated that in any of these embodiments, any textured surface may be used where appropriate. In this embodiment, the razor blade device 800 includes two cartridge structures 820 and 820', located along one side and along an upper edge, respectively, of the base support portion 846. In essence, the hair razor blade device 800 is a combination of the embodiments shown in Figures 18 and 19. Accordingly, the cartridge structure 820, of a generally concave shape, is most suitable for shaving convex skin surfaces, while the cartridge structure 820', of a convex configuration, is most suitable for shaving concave skin surfaces. It will be appreciated that the cartridge structures 820 and 820' are most preferably of similar structure as those embodiments previously demonstrated. A pair of covers 890 and 890' are also provided for shielding one or both of the cartridge structures 820 and 820?, which may be made from thin, transparent plastic material or any other suitable material.

Figures 21 through 23 show another embodiment of curved hair razor blade device, generally at 900. The razor blade device 900 includes a structure 902, which includes a handle portion 910 and a base support portion 946. The structure 902 is preferably of a generally in-line configuration, such that the handle portion 910 and the base support portion 946 are aligned generally upon a longitudinal axis of the razor blade device 900. This configuration allows for in-line shaving by manual movement of the device. The handle portion 910 may preferably be of a flattened, elongated configuration for facilitating gripping by hand. As shown in Figures 21 and 22, the handle portion 910 may preferably include means for facilitating gripping, such as gripping portion 995, which includes a plurality of irregularly raised surfaces.

The base support portion 946 includes a recess 947 for attachment of a cartridge structure 920. The cartridge structure 920 is preferably a blade structure having a precurved configuration, for facilitating the shaving of curved body surfaces. It will be appreciated that the degree of curvature may be adjusted to accommodate the particular need. The base support portion 946 includes a blade support platform 934 that is insertable within the recess 947. The base support portion 946 is retained in a removable engagement with the base support portion 946 through the releasable engagement of tabs 936 with slots 937.

The cartridge structure 920 may be any blade structure that is suitable for

accomplishing the desired need. In particular, the cartridge structure 920 may be a single or multiple blade structure that is capable of shaving in one or two opposite directions. In the embodiment shown in Figures 21-23, the preferred configuration for the cartridge structure 920 is a double-bladed structure, each blade having opposing razor-sharpened edges, and configured for bi-directional shaving.

One especially preferred configuration of cartridge structure suitable for use in any embodiment described herein is set forth in Figures 24-28. Figure 24 shows a cartridge structure, generally at 1020, which includes a floating blade configuration. This floating blade configuration allows the blades to pass over irregularities in the skin surface over which the blades travel. The cartridge structure 1020 may include one or more floating blade structures. In the embodiment shown in Figure 24, two opposing pairs of floating blade structures are shown at 1022, 1024, 1026 and 1028. This arrangement is operable for providing bi-directional shaving using a double-bladed design for each shaving direction. The cartridge structure 1020 includes means for attachment to a base support portion 1046, which may be of any configuration discussed herein. To accomplish this attachment, the cartridge structure 1020 is shown to include a blade support platform 1034 having tabs 1036 that interlock with slots 1037 located within a recess 1047 of the base support portion 1046.

The cartridge structure 1020 further includes a blade base structure 1030 that is operable for supporting the floating blade structures 1022, 1024, 1026 and 1028. The floating blade structures 1022, 1024, 1026 and 1028 include, respectively, curved blade strips 1040, 1041, 1042 and 1043. The curved blade strips 1040, 1041, 1042 and 1043 are shown to be attached to curved support beams 1060, 1061, 1062 and 1063 through spot welds 1070, 1072, 1074 and 1076. The curved support beams may preferably be of an L-shaped configuration, as shown in Figure 27. It will be understood, however, that any suitable configuration may be used which accomplishes the results described herein. The floating blade structures 1022, 1024, 1026 and 1028 also include means for suspending the curved blade strips 1040, 1041, 1042 and 1043 in a movable manner at a location suitable for accomplishing shaving. This is provided in Figures 24-26, through the use of a plurality of suspension members, designated for each floating blade structure at 1064, 1065, 1066, and 1067. In the examples shown in Figures 25 and 26, demonstrating the floating blade structure 1026 as an example, a plurality of suspension members 1066 are provided for suspending the curved support beam 1062 above the blade base structure 1030. The interaction of the suspension

members 1064, 1065, 1066 and 1067 with the curved support beams 1060, 1061, 1062 and 1063 are intended to provide a limited range of floating movement for each of the floating blade structures. To provide a limited range of floating movement, the curved support beams 1060, 1061, 1062 and 1063 are provided with slots 1080, 1082, 1084 and 1086 which interact with pins 1090, 1092 and 1094 to regulate the limited range of travel for the floating blade structures 1022, 1024, 1026 and 1028 as a whole. Figures 25 and 26 show the resulting deflection of any of the suspension members, such as 1066, in response to a force applied (shown at arrow in Figure 26) to any portion of any of the curved blade strips, such as at 1042. In Figure 25, the position of the curved support beam 1062 is maintained through the force exerted by the suspension members 1066 and the restraint provided by the interaction of pins 1092 with slots 1084. In Figure 26, the force applied against a portion of the curved blade strip 1042 causes deflection of at least some of the suspension members 1066, accompanied by a change in relative position between the pins 1092 and the slots 1084.

The pins 1090, 1092 and 1094 may preferably be inserted within the cartridge structure 1020 through apertures 1096, 1097 and 1098. As with previous embodiments, a lubricant strip 1050, of similar type as before, may be employed upon the cartridge structure 1020. The cartridge structure 1020 employs the same principal as in previous embodiments, namely, that the blade structure or structures are operable to form a working plane or planes with the surrounding portions of the cartridge structure 1020, and the lubricant strip 1050 where applicable. Thus, the surfaces of the cartridge structure 1020 and/or the lubricant strip 1050, are operable to provide front and rear guard surfaces for the floating blade structures employed.

Another embodiment, showing another configuration for a floating blade structure suitable for use in the present invention, is shown in Figures 28-30. Specifically, Figure 28 shows an exploded side view of a cartridge structure, generally at 1120. The cartridge structure 1120 is a double-bladed structure including flexible components and components having flexible sections, which mate with a pre-curved platform structure, resulting in a curved configuration for the cartridge structure 1120 as a whole. The cartridge structure 1120 is also shown to be of an independent floating configuration, in that multiple sections of the cartridge structure 1120 are intended to be displaceable on an independent basis during shaving.

The cartridge structure 1120 includes a multi-layered configuration of

components that are each designed to be flexible, providing flexibility for the cartridge structure 1120 as a whole. The cartridge structure 1120 includes a blade cap structure 1130. The blade cap structure 1130 includes support units 1135 which are of a generally rigid configuration. The blade cap structure 1130 also includes flexible sections 1136 that are preferably integrally formed with the support units 1135. Alternatively, it will be appreciated that the flexible sections 1136 may be of a different material, and may also optionally be attached through any suitable means to the support units 1135. In the embodiment shown in Figure 28, the flexible sections 1136 are constructed of the same material as the support units 1135, but achieve their flexibility due to their substantially thinner cross-section. The blade cap structure 1130 also includes recesses 1133 within each support unit 1135 for receiving locking pins 1131 therewithin. Preferably, the recesses 1133 are sized to substantially correspond to the head size of the locking pins 1131. In this arrangement, the heads of the locking pins 1131 form a substantially flush surface with the blade cap structure 1130 when the locking pins 1131 are in an inserted position.

The cartridge structure 1120 also includes blade strips 1140 and 1145. These blade strips are preferably flexible and are constructed from the same materials previously described. Spacers 1132 are preferably included between the blade strips 1140 and 1145. The cartridge structure 1120 further includes a first flexible platform 1160. The first flexible platform 1160 is preferably designed so that it may correspond in configuration to the remaining components of the cartridge structure 1120. Accordingly, the first flexible platform 1160 includes platform units 1161 which may be of a generally rigid configuration, although it will be appreciated that the platform units 1161 may also have some flexibility. The first flexible platform 1160 further includes flexible sections 1162 disposed between the platform units 1161. These flexible sections 1162 impart flexibility to the first flexible platform 1160 as a whole. In similar manner as with the flexible sections 1136, the flexible sections 1162 may preferably be made of the same material as the platform units 1161, obtaining their flexibility through thinner cross-section. The platform units 1161 include prongs 1163 for attachment to other components of the cartridge structure 1120, as described below. Ribs 1164 located upon the platform units 1161 are also provided, to assist in stretching the skin and causing hairs to stand up. The ribs 1164 also establish a working plane with the blade cap structure 1130 relative to the blade strips 1140 and 1145, as shown in Figures 29 and 30.

The cartridge structure 1120 also includes a second flexible platform 1170 that is adapted for engaging the first flexible platform 1160. The second flexible platform 1170 includes platform units 1171 which may preferably be of a substantially similar nature as the platform units 1161. The second flexible platform 1170 also includes flexible sections 1172, which impart flexibility to the second flexible platform 1170, in similar manner as before. Recesses 1173 are provided within each of the platform units 1171 for receiving the prongs 1163 from the platform units 1161. The cartridge structure 1120 further includes a suspension platform 1180 having suspension units 1181. In the embodiment shown in Figure 28, the suspension units 1181 are configured to provide independent suspension to each side of each of the platform units 1171. The suspension platform 1180, including the suspension units 1181, are preferably constructed of a resilient plastic material, although it will be appreciated that any suitable material, such as a metal material, may be used.

As shown in Figures 28-30, engagement of the locking pins 1131, the blade cap structure 1130, the blade strips 1140 and 1145, the spacers 1132, the first flexible platform 1160, the second flexible platform 1170, and the suspension platform 1180 with the underlying blade support platform 1134 is intended to complete the cartridge structure 1120. The blade support platform 1134 is of a generally precurved configuration, which guides the degree of curvature for the cartridge structure 1120 as a whole.

Another embodiment of floating blade structure is illustrated in Figure 31. In this embodiment, the first flexible platform 1160 and the second flexible platform 1170 from Figures 28-30 are effectively combined to yield a single flexible platform. Thus, Figure 31 shows a cartridge structure generally at 1220, having multiple flexible sections that mate with a blade support platform, in similar manner as before. A blade cap structure 1230 includes support units 1235 that are separated by flexible sections 1236. Recesses 1233 are provided for allowing the flush insertion of locking pins 1231. Blade strips 1240 and 1245 are also provided, separated by spacers 1232. In this embodiment, the first and second flexible platforms from the previous embodiment are effectively combined. This combination yields a first flexible platform 1260 having platform units 1271 separated by flexible sections 1262. The platform units 1271 include ribs 1264, in similar manner as before. The platform units 1271 provide surfaces for engaging suspension units 1281 disposed upon the suspension platform 1280. Each of these components mates with the blade support platform 1234, which is

of a generally curved configuration, as shown in Figure 31.

Figures 32 and 33 illustrate the use of the curved hair razor blade devices of the present invention. Specifically, Figure 32 shows a curved-hair razor blade device 1300, which may be any of the devices in any embodiment set forth herein. The razor blade device 1300 is shown to be gripped at handle portion 1310 and is operable for being sequentially and repetitively tilted back and forth for alignment of the working planes previously described to accomplish bi-directional shaving. As shown in Figure 32, the curved-hair razor blade device 1300 is tilted and moved in a back-and-forth direction over a human leg 1362 in the directions indicated by the arrows 32R and 32L. Figure 33 shows the configuration of the handle portion 1310 in more detail, including grip recesses 1312 and 1314 for facilitating holding of the curved-hair razor blade device 1300. As shown in Figure 33, one preferred configuration for holding the handle portion 1310 is between the thumb and forefinger, although it will be appreciated that any desired gripping configuration may also be used.

Figures 34 through 37 illustrate alternative handle portion configurations contemplated by the present invention. Specifically, Figure 34 shows a curved-hair razor blade device generally at 1400, which may be any of the embodiments of razor blade device set forth herein. The curved-hair razor blade device 1400 includes a handle portion 1410, in similar manner as before. In this embodiment, however, the handle portion 1410 is of a generally square cross-section. This configuration allows for a different gripping configuration by the hand and/or fingers, which may be desirable for some users. As shown in Figures 35-37, the square cross-section of the handle portion 1410 can be rotated between the fingers in any desired configuration during use. Specifically, Figures 35-37 show three different orientations of the thumb and forefinger for holding the handle portion 1401. It will be appreciated that any other suitable configuration for the hand and/or fingers may also be used. Thus, the present invention contemplates the inclusion of different handle configurations as may be desirable for facilitating use of this device.

Figure 38 shows the configuration advantages gained by use of the independent floating platform configuration set forth in Figures 24-31. Specifically, Figure 38 shows a blade support platform1534, which may represent the blade support platform for any of the embodiments described herein, with five curves A through E. The curves A through E illustrate how the flexible curved blade structures of the present invention are held in an "at rest" position (illustrated by solid lines) and may be

converted to multiple curved positions (illustrated by dotted lines) through contact with irregular surfaces of the skin. Sets A through C represent potential degrees of freedom for the razor blade strip structures set forth in Figures 24-27. As shown in set A, razor blade strip structure is initially at rest period 1502 and may be pressed against a shaving surface such as a user's face and moved to position 1504. As shown in set B, a flexible razor blade strip may initially assume a position again of 1502 and may be moved at a slight angle thereby assuming position 1506. Set C shows the flexible razor blade strip initially at a position 1502 and then moved at an angle to position 1508. It is noted that blade, itself, is in a rigid state and is allowed to move as one solid unit. Alternatively, sets D and E show potential degrees of freedom for the floating flexible razor blade strip structures of Figures 28-31. Because the blade strip structures in these embodiments are completely flexible and able to conform to various configurations of shaving surfaces such as a user's face, they are able to flex with greater variations than the blade strip structures of the Figure 24-27 embodiments.. Specifically, set D shows flexible razor blade strip at an initial position of 1502 and then a contorted position of 1510, whereby 1510 may represent an extreme pressure towards the center of the blade and a relatively lesser force at the periphery thereof. Set E, again, shows the flexible razor blade strip at the initial position of 1502 and then at the contorted position of 1512. Position 1512 can illustrate the curvature of a bumpy shaving surface such as a rough human face. Thus, the blade is allowed to contort from position 1502 to 1512 thereby maximizing shaving effectiveness.

Figures 39-42 illustrate another embodiment of curved razor blade device according to the present invention. In this embodiment, a cartridge structure is provided, generally at 1620. The cartridge structure may preferably have the same overall configuration as the cartridge structures 320 or 420 in Figures 12 and 13. It will be appreciated that this may include any combination of single or multiple blade strips, single or bi-directional shaving capability and working planes formed through the cooperation of guard surfaces adjacent the blade strip edges, as previously described herein. The cartridge structure 1620 is designed to have two different curvatures making up an integrally formed shaving structure. Specifically, the cartridge structure 1620 includes a curved section, designated by the letter "A" disposed adjacent a more gently curved section, designated as "B". The advantage of adjacently disposed sections of different curvature involves the capability of simple movement along the cartridge structure surface to enhance shaving of body areas of different convex

curvatures. In practice, skin surfaces having more gentle curvatures can be shaved using the more gently curved B section, while skin surfaces of sharper curvature can be shaved using the more curved A section of the device.

Specifically, the components of the cartridge structure 1620 are shown in Figure 39. Thus, the cartridge structure 1620 includes a blade cap structure 1630, blade strips 1640 and 1645, separated by spacers 1632, disposed upon a blade support platform 1634. As before, a lubricant strip 1650 may be placed for contact with the skin surface during shaving. Figure 40 shows the cartridge structure 1620 being used for the shaving of a human calf. Since the human calf is of an intermediate radius of curvature, a suitable location along the cartridge structure 1620 for accomplishing this shaving is near the inner section of the Sections A and B. Figure 41 shows the cartridge structure 1620 being placed upon a human ankle 1670, which is of somewhat smaller radius of curvature than the human calf 1660 shown in Figure 40. Thus, the use of Section A of the cartridge structure 1620 is especially suited for this type of shaving. Figure 42 shows the use of the cartridge structure 1620 for shaving a human thigh 1680. Since the human thigh 1680 is of a somewhat larger radius of curvature than the human calf 1660 or human ankle 1670, Section B of the cartridge structure 1620 is best suited for this shaving purpose. Thus, it will be appreciated that shaving of body sections having different curvatures can be easily accomplished by simple selecting the most desirable curvature along the surface of the cartridge structure 1620.

It will be appreciated that the degrees of curvature of the shaving Sections A and B of the cartridge structure 1620 do not exactly match the curvatures of the skin's surfaces being shaved. Nonetheless, since pressing of the cartridge structure 1620 against the skin's surface typically causes the skin's surface to be somewhat flattened, it is believed that the degrees of curvature shown in Figures 39-42 will enhance and facilitate shaving of these curved surfaces. However, it will be appreciated that the present invention contemplates the overall concept of adjusting the relative curvatures of these cartridge structures to any degree desired for facilitating shaving of a particular curved body surface. In addition, it will be appreciated that the present invention contemplates the overall concept of combining differently curved portions of one or more cartridge structures or structure portions upon a base support portion along with a suitable handle portion or combinations of handle portions for affectively accommodating the shaving of different body surfaces.

Another embodiment of the present invention is set forth in Figures 43 and 44. In this embodiment, a thin wire is wrapped around the exposed edge or edges of the blade strip or strips at spaced intervals to reduce the likelihood of nicks and scrapes on the skin's surface from contact with one or more blade strips. Specifically, Figure 43 shows a cartridge structure 1720, which may be any cartridge structure described herein. The cartridge structure 1720 includes a blade cap structure 1730 having a lubricant strip 1750 disposed thereupon, in a similar manner as previously described. The cartridge structure 1720 also includes blade strips 1740 and 1745 and a blade support platform 1734. In this embodiment, a thin wire 1790, which may be made of any suitable material, is wrapped around the exposed edges of the blade strips 1740 and 1745. Preferably, the wire 1790 is wrapped around the blade strips 1740 and 1745 at regular intervals. As shown in Figure 43, the wire 1790 is preferably wrapped in a perpendicular relation relative to the edges of the blade strips 1740 and 1745. It will be appreciated, however, that any other wrapping configurations deemed suitable may also be used. The blade cap structure 1730 may preferably be placed over the wire 1790, also as shown in Figure 43. Figure 44 illustrates a perspective view of this arrangement, and also illustrates the route through which the wire 1790 crosses between passages over the blade strips 1740 and 1745.

Figure 45 sets forth another embodiment of the present invention, in which a curved section is disposed adjacent to a more gently curved, or almost straight, section upon a base support portion. Specifically, Figure 45 shows two adjacently disposed cartridge structures 1820 and 1820'. The cartridge structures 1820 and 1820' include, respectively, blade support platforms 1834 and 1834', blade strips 1840 and 1840' separated by spacers 1832 and 1832', blade cap structures 1830 and 1830' and lubricant strips 1850 and 1850', in similar manner as before. Also, in similar manner as before, this configuration of shaving device is capable of shaving convexly curved body surfaces of small radius, such as a human ankle 1870, or of larger radius, such as human thigh 1880.

While the above embodiments have been described in connection with particular examples, it will be appreciated that any combination of any of the features of the above embodiments may be used interchangeably among the various embodiments to produce razor blade devices having the desired configuration and/or structure. Thus, it is to be understood that the present invention also encompasses any modifications or equivalents within the scope of the discosures that are fairly

covered by the claims set forth below.

CLAIMS

I Claim:

1. A curved blade shaving device for shaving hair from curved body surfaces comprising:

a structure having a base support portion and a handle portion; and

a cartridge structure operable for being releasably attached to said base support portion and operable for being deflected in response to body surface contours, said cartridge structure comprising:

(a) at least one blade strip disposed in communication with said blade support platform, each blade strip having at least one sharpened edge;

(b) a front guard surface disposed in a spaced proximity from each sharpened edge; and

(c) a rear guard surface disposed in a spaced proximity from each sharpened edge;

wherein a working plane for shaving with said at least one sharpened edge is established through the cooperation of said front and said rear guard surfaces;

wherein said curved-blade shaving device is operable for shaving upon tilting said blade support platform in a first direction to bring said working plane into at least tangential contact with a skin surface and moving said curved-blade shaving device across said skin surface in said first direction.

2. The curved-blade shaving device according to Claim 1, wherein said front guard surface is a blade cap structure and said rear guard surface is a blade support platform having at least one edge, wherein said working plane for shaving is established through the cooperation of said cap structure and said blade support platform.

3. The curved-blade shaving device according to Claim 1, wherein at least a portion of said cartridge structure is operable for being bent from a substantially flat configuration to a curved configuration for mounting upon said base support portion.

4. The curved-blade shaving device according to Claim 1, wherein at least a portion of said cartridge structure is provided in a precurved configuration.

5. The curved-blade shaving device according to Claim 1, wherein said cartridge structure comprises a pair of blade strips.

6. The curved-blade shaving device according to Claim 1, wherein said cartridge structure is formed in a longitudinal plane of said curved-blade shaving device, and wherein said base support portion and said handle portion are in an in-line configuration along said longitudinal plane.

7. The curved-blade shaving device according to Claim 1, said blade support platform having at least one edge, said guard member having at least one edge, and wherein a working plane for shaving is formed through the cooperation of a sharpened edge of at least one blade strip, an edge of said blade support platform disposed in a spaced proximity from said sharpened edge and an edge of said guard member disposed in a spaced proximity from said sharpened edge.

8. The curved-blade shaving device according to Claim 1, said blade support platform having at least one edge, at least one of said guard surfaces having at least one edge, wherein said cartridge structure comprises a pair of blade strips disposed in communication with said blade support platform, and wherein a working plane for shaving is established through the cooperation of a sharpened edge of each blade strip, an edge of said blade support platform and an edge of said at least one guard surface, said edge of said blade support platform and said edge of said at least one guard surface both being disposed in a spaced proximity from said sharpened edge.

9. The curved-blade shaving device according to Claim 1, said blade support platform having a pair of generally opposing edges, at least one of said guard surfaces having a pair of generally opposing edges, each blade strip having a pair of generally opposing sharpened edges, and wherein generally opposing working planes for shaving are established through the cooperation of said generally opposing sharpened edges, generally opposing edges of said blade support platform and generally opposing edges of said at least one guard surface, said edges of said blade support platform and said edges of said at least one guard surface being disposed in a spaced proximity from said sharpened edges.

10. The curved-blade shaving device according to Claim 1, said blade support platform having a pair of generally opposing edges, at least one of said guard surfaces having a pair of generally opposing edges, wherein said cartridge structure comprises a pair of blade strips disposed in communication with said blade support platform, each blade strip having a pair of generally opposing sharpened edges, and wherein generally opposing working planes for shaving are established through the cooperation of opposing sharpened edges of each blade strip, opposing edges of said blade support platform and opposing edges of said at least one guard surface, said edges of said blade support platform and said edges of said at least one guard surface being disposed in a spaced proximity from said sharpened edges.

11. The curved-blade shaving device according to Claim 1, wherein said cartridge structure is of a symmetrical configuration relative to a plane of symmetry that is perpendicular to a plane tangent to a curved body surface to be shaved when said device is placed in proximity to said curved body surface.

12. The curved-blade shaving device according to Claim 11, said blade support platform having a pair of generally opposing edges spaced equidistant from said plane of symmetry, each blade strip having generally opposing sharpened edges spaced equidistant from said plane of symmetry, and at least one guard surface having a pair of generally opposing edges spaced equidistant from said plane of symmetry.

13. The curved-blade shaving device according to Claim 1, wherein said device is operable for bi-directional shaving by sequentially:

(a) placing said device in proximity with a surface to be shaved;

(b) tilting said device in a first direction suitable for shaving in said first direction by placing a first working plane of said device substantially tangent to a surface to be shaved;

(c) moving said device along said surface in said first direction;

(d) tilting said device in a second direction suitable for shaving in said second direction by placing a second working plane of said device substantially tangent to a surface to be shaved; and

(e) moving said device along said surface in said second direction.

14. The curved-blade shaving device according to Claim 1, wherein said cartridge structure comprises from an exterior surface to an interior surface of said device, and in increasing width from said exterior surface to said interior surface, a guard surface, a first blade strip, a second blade strip and a blade support platform, each blade strip having a pair of generally opposing sharpened edges, said first blade strip having a width greater than a width of said second blade strip, such that the cooperation of the sharpened edges of said blade strips forms two working planes for shaving hair.

15. The curved-blade shaving device according to Claim 1, wherein said cartridge structure is releasably attached to said base support portion in a concave configuration suitable for the shaving of a convex skin surface.

16. The curved-blade shaving device according to Claim 1, wherein said cartridge structure is releasably attached to said base support portion in a convex configuration suitable for the shaving of a concave skin surface.

17. The curved-blade shaving device according to Claim 1, wherein said cartridge structure is releasably attached to said base support portion by being inserted at least partially within a trough formed along an edge of said base support portion.

18. The curved-blade shaving device according to Claim 1, comprising first and second cartridge structures releasably attached to said base support portion.

19. The curved-blade shaving device according to Claim 18, wherein said first cartridge structure is releasably attached to said base support portion in a concave configuration suitable for the shaving of a convex skin surface and said second cartridge structure is releasably attached to said base support portion in a convex configuration suitable for the shaving of a concave skin surface.

20. The curved-blade shaving device according to Claim 1, wherein said cartridge structure includes both concave and convex portions in a continuous structure.

21. The curved-blade shaving device according to Claim 1, further comprising a cover for shielding at least a portion of said cartridge structure.

22. A curved-blade shaving device for shaving hair from curved body surfaces comprising:

a base support portion; and

a flexible cartridge structure of a symmetrical configuration relative to a plane of symmetry that is perpendicular to a plane tangent to a curved body surface to be shaved when said device is placed in proximity to said curved body surface, said cartridge structure operable for being releasably attached to said base support portion, said cartridge structure comprising:

(a) a blade support platform having a pair of generally opposing edges spaced equidistant from said plane of symmetry;

(b) a pair of spaced apart blade strips disposed in communication with said blade support platform, each blade strip having a pair of generally opposed sharpened edges spaced equidistant from said plane of symmetry; and

(c) at least one guard member having a pair of generally opposing edges spaced equidistant from said plane of symmetry;

wherein generally opposing working planes for shaving are established through the cooperation of opposing sharpened edges of each blade strip, opposing edges of said blade support platform and opposing edges of said guard member, said edges of said blade support platform and said edges of said guard member being disposed in a spaced proximity from said sharpened edges;

wherein said cartridge structure is operable for being bent from a substantially flat configuration to a curved configuration for mounting upon said base support portion; and

wherein said device is operable for bi-directional shaving by sequentially:

(a) placing said device in proximity witha surface to be shaved;

(b) tilting said device in a first direction suitable for shaving in said first direction by placing a first working plane of said device substantially tangent to a surface to be shaved;

(c) moving said device along said surface in said first direction;

(d) tilting said device in a second direction suitable for shaving in said

second direction by placing a second working plane of said device substantially tangent to a surface to be shaved; and

(e) moving said device along said surface in said second direction.

23. A curved-blade shaving device operable for shaving hair in two directions from curved body surfaces, said device comprising:

a base support portion; and

a flexible cartridge structure including at least one blade strip having generally opposing sharpened edges, said cartridge structure having at least one curved section that is pre-curved to correspond to a curved body surface to be shaved, said cartridge structure having at least one elongated guard having generally opposing edges disposed adjacent to, but spaced from, said sharpened edges of each blade strip, the cooperation of said generally opposed sharpened edges of each blade strip and said generally opposed edges of said elongated guard being operable to form generally opposed working planes for the shaving of hair.

24. The curved-blade shaving device according to Claim 23, wherein said cartridge structure includes front and rear elongated guards, each having generally opposing edges disposed adjacent to, but spaced from, said sharpened edges of each blade strip, the cooperation of said generally opposed sharpened edges of each blade strip and said generally opposed edges of said front and rear elongated guards being operable to form generally opposed working planes for the shaving of hair.

25. The curved-blade shaving device according to Claim 23, wherein said cartridge structure includes a pair of spaced apart blade strips, each having generally opposing sharpened edges.

26. The curved-blade shaving device according to Claim 23, further comprising a handle portion attached to said base support portion.

27. A curved-blade shaving device having a curved razor blade strip arrangement for shaving hair from curved body surfaces such as legs and arms, the shaving device comprising:

a thin elongated razor blade strip platform structure having a length, height

and width and a plane of reference, hereinafter called the common plane, oriented along its length and height, and having elongated front and rear guard members which are curved when the shaving device is viewed in side elevation from a point spaced from and perpendicular to the common plane, the front guard member being arranged along and about a front plane spaced from and substantially parallel to the common plane, the rear guard member being arranged along and about a rear plane substantially parallel to the common plane;

a hand grip portion of predetermined shape having a length, height and width and arranged along its length and height substantially along the common plane;

an elongated curved base support structure having a length, height and width and being arranged with its length and height substantially along the common plane, and wherein

the base support structure is rigidly connected to the hand grip portion, with the length of the base support structure and the length of the hand grip portion being generally parallel to one another,

the base support structure is connected to and supports the platform structure for movement across curved skin surface areas of a user's body to be shaved with the device,

the platform structure further includes at least one elongated generally ribbon-like very thin flexible razor blade strip having at least one elongated razor-sharp blade edge for shaving hair which extends along and is positioned in close relation between, but is spaced from the front and rear guard members, and

when the platform structure is attached to the curved base support structure, a curved working plane is defined by and present through the cooperation of the front and rear guard members, with the guard members and razor blade strip being maintained in a generally curved configuration and with the razor-sharp blade edge being both in a plane substantially parallel to the common plane and projecting at an acute angle into the curved working plane,

whereby the curved-blade shaving device is useful for shaving hair from skin on curved body portions having a substantially similar contour to the curved working plane using the curved razor-sharp blade edge located between the front and rear guard members.

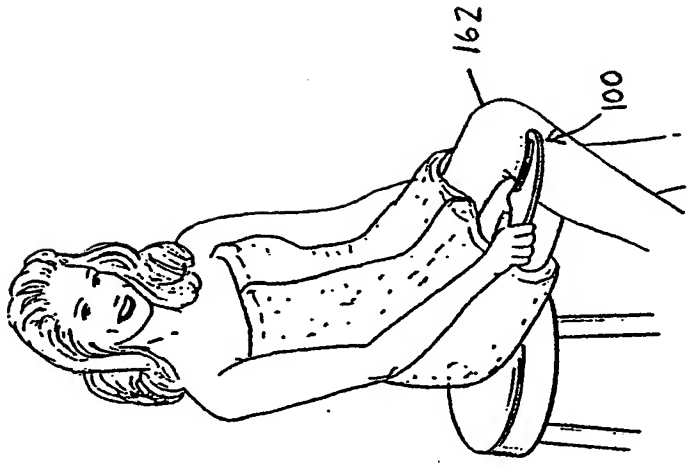


FIG-3

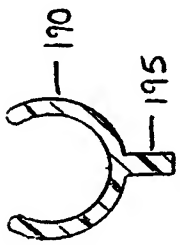


FIG-5

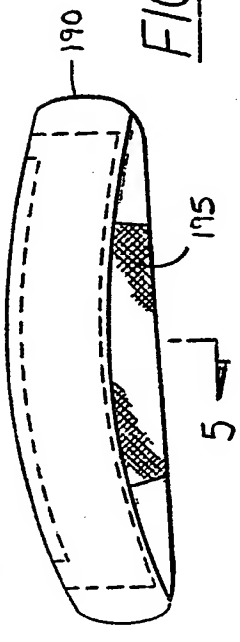


FIG-4

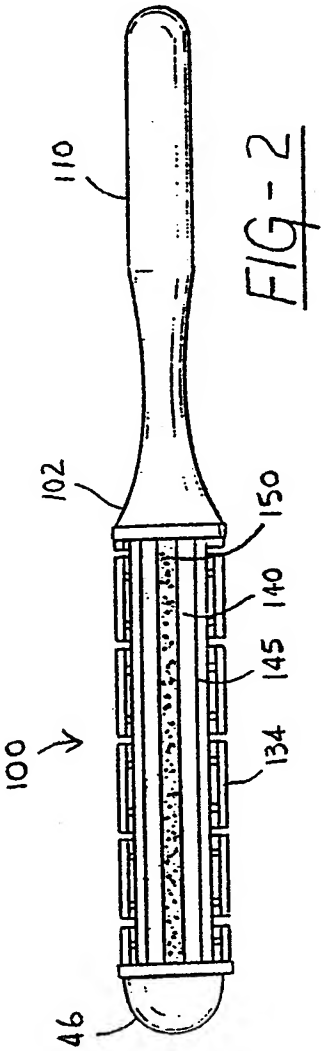


FIG-2

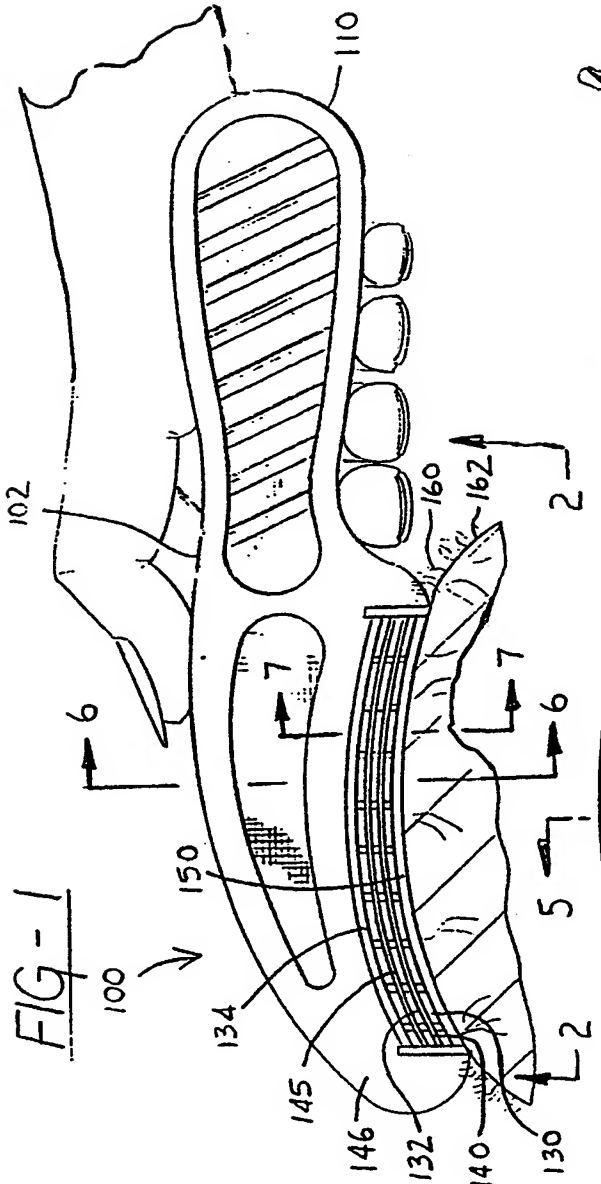


FIG-1

FIG - 6

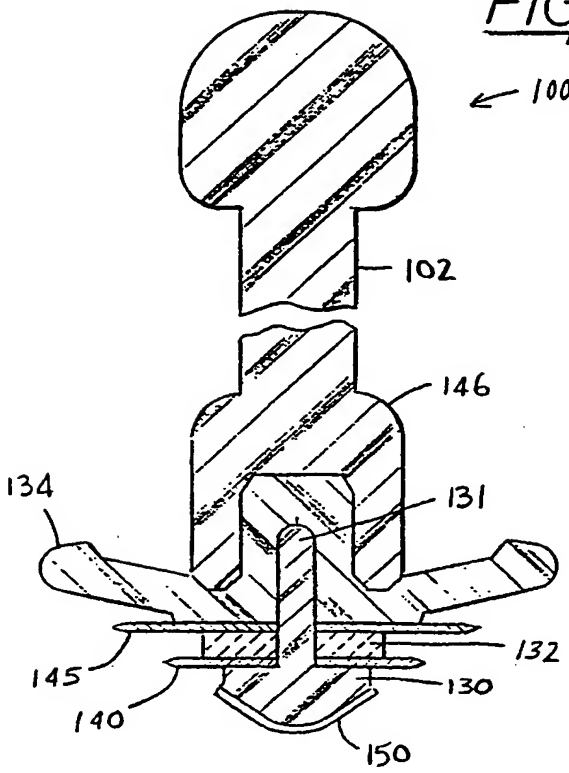
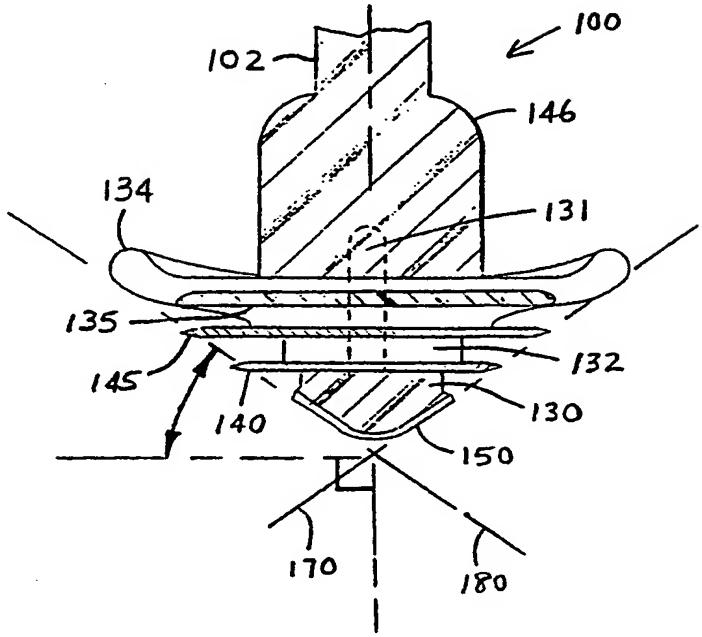


FIG - 7



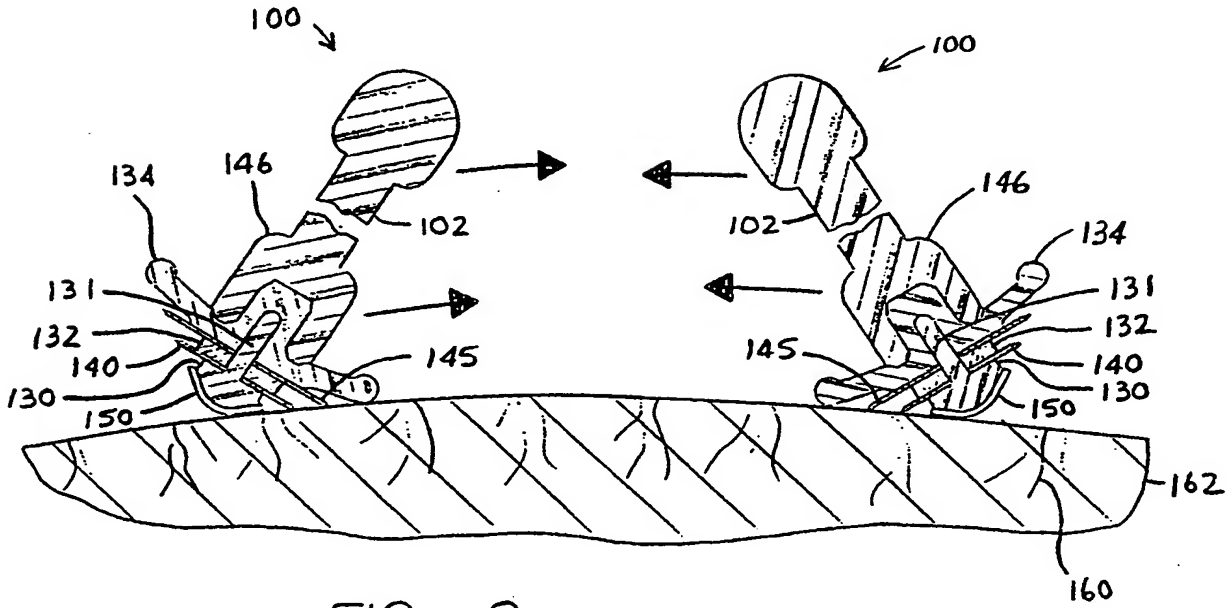
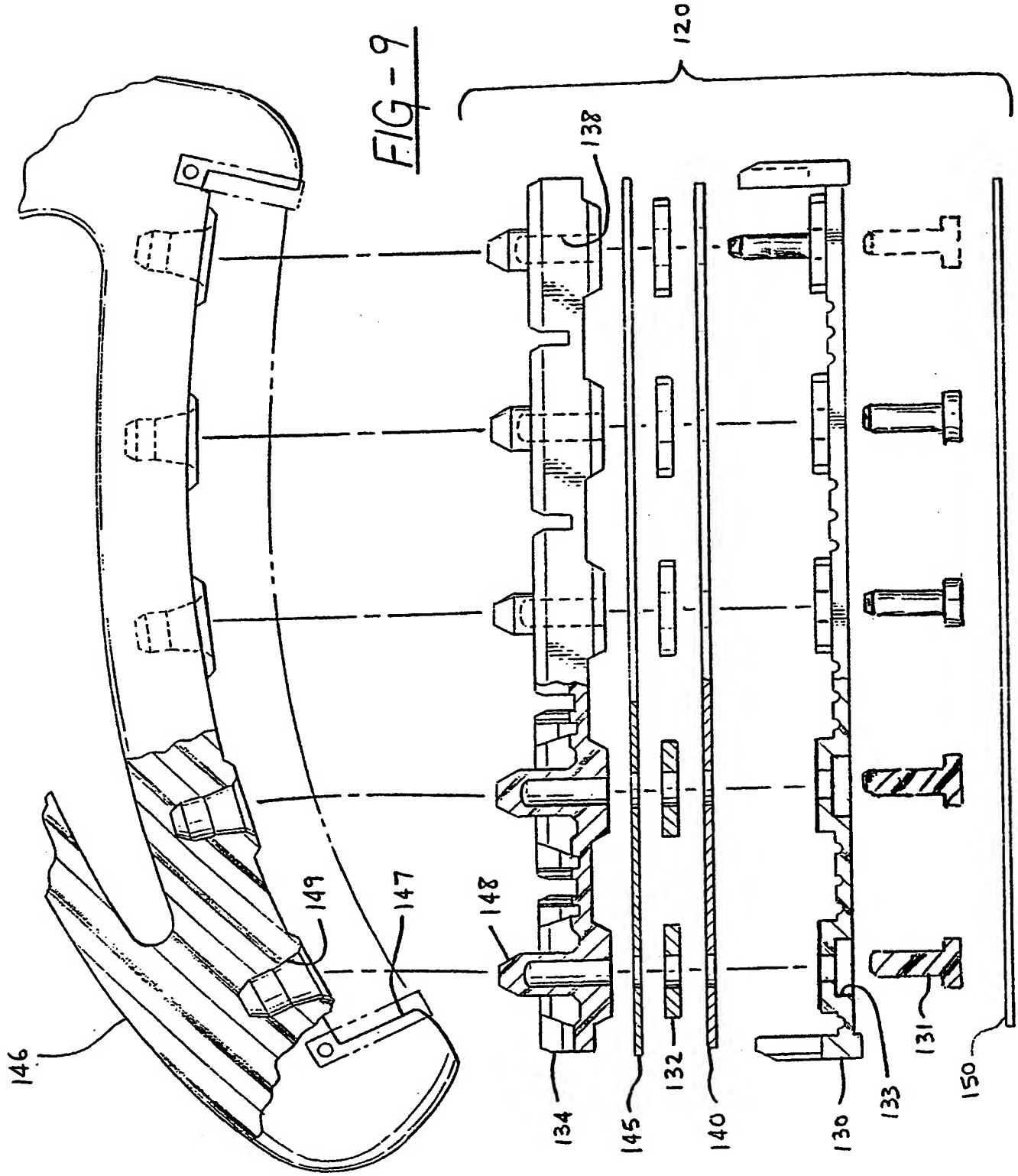
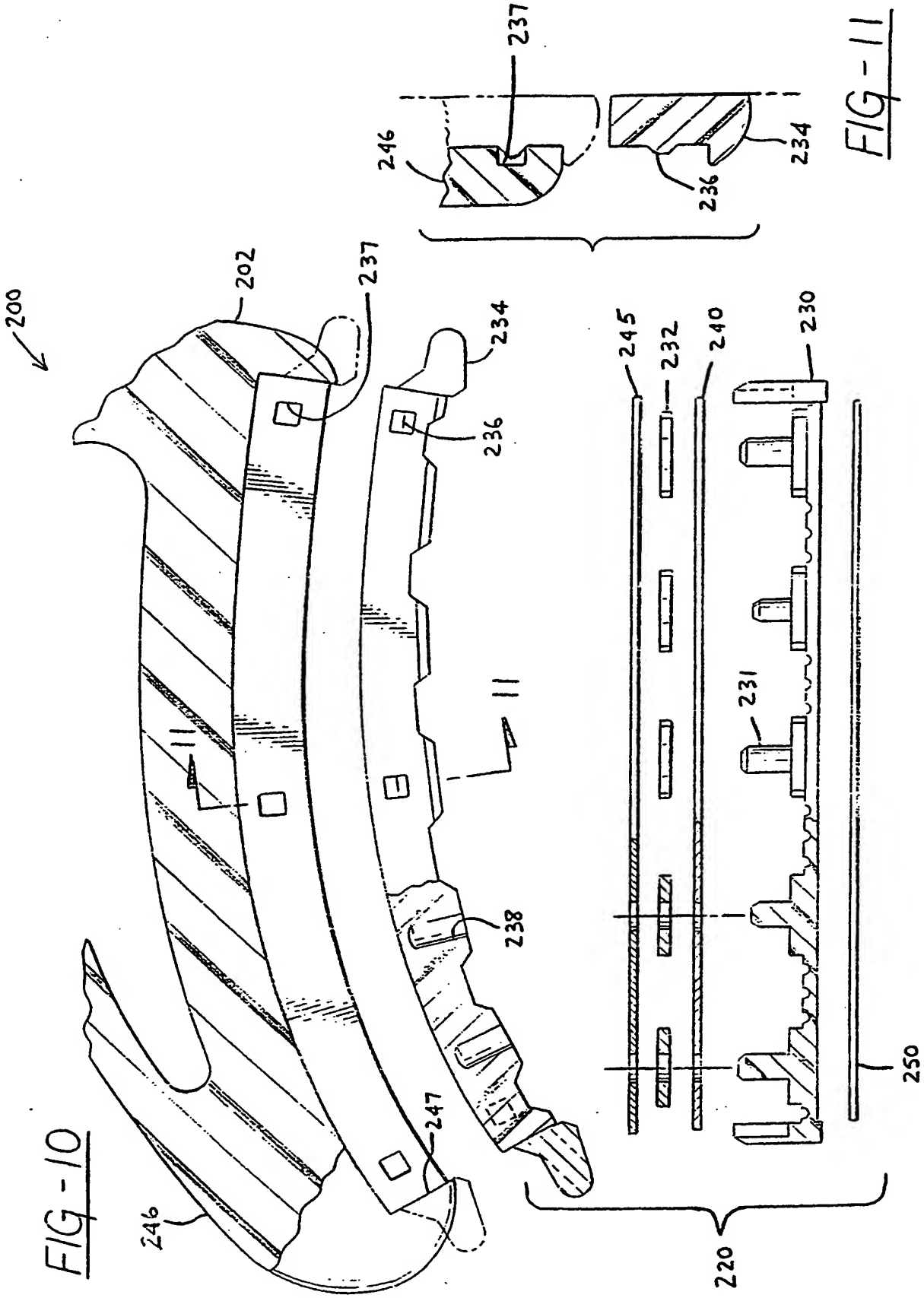


FIG - 8

FIG-9





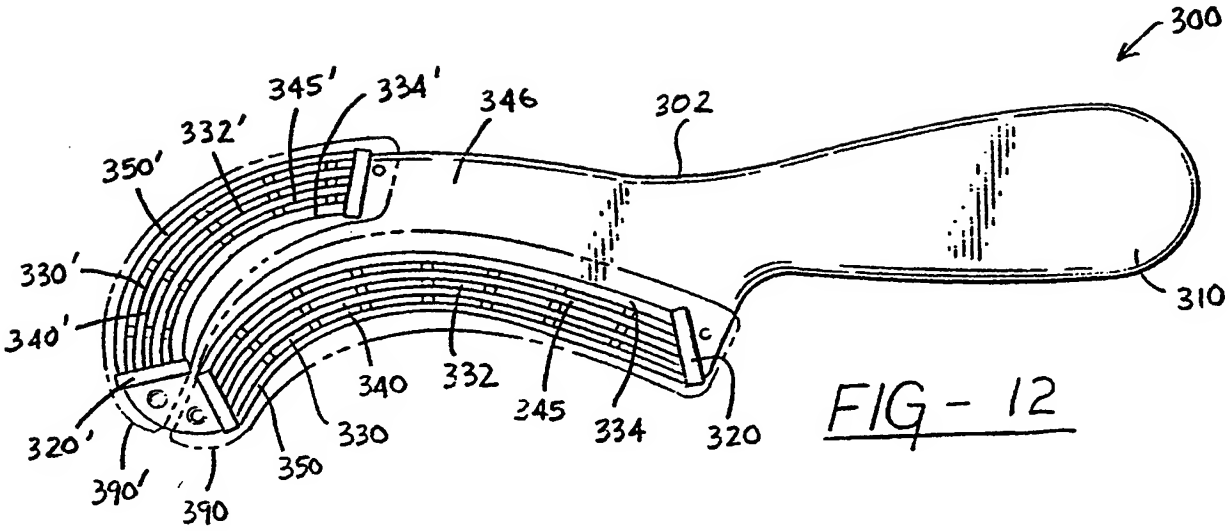


FIG - 12

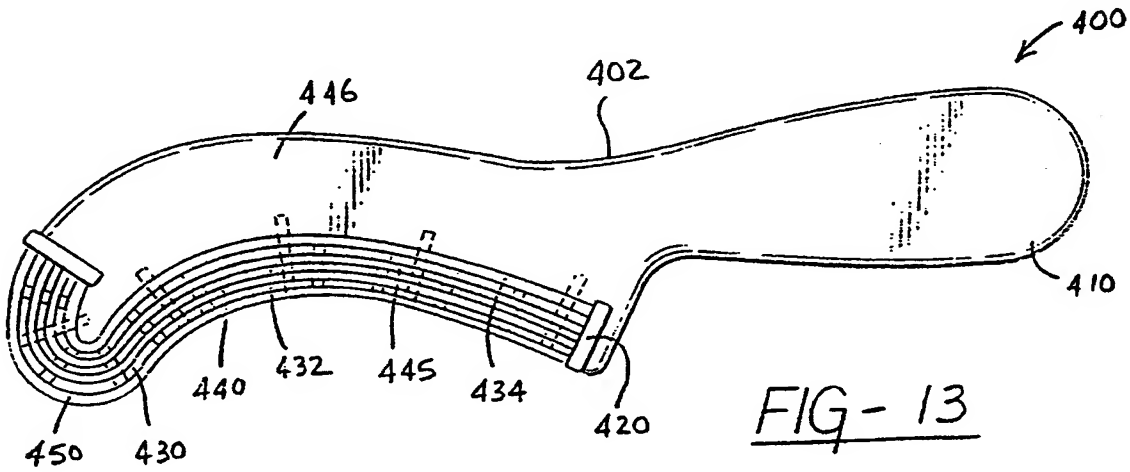


FIG - 13

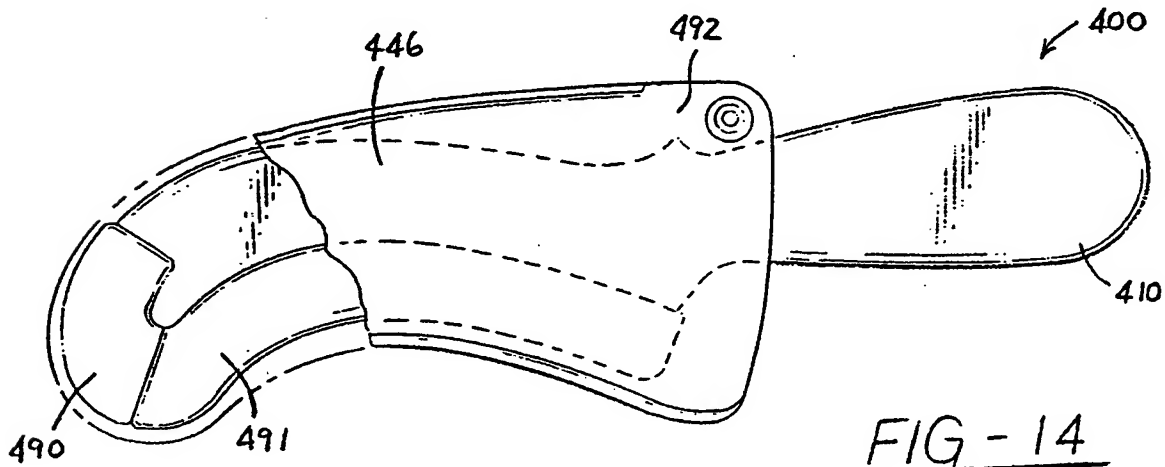


FIG - 14

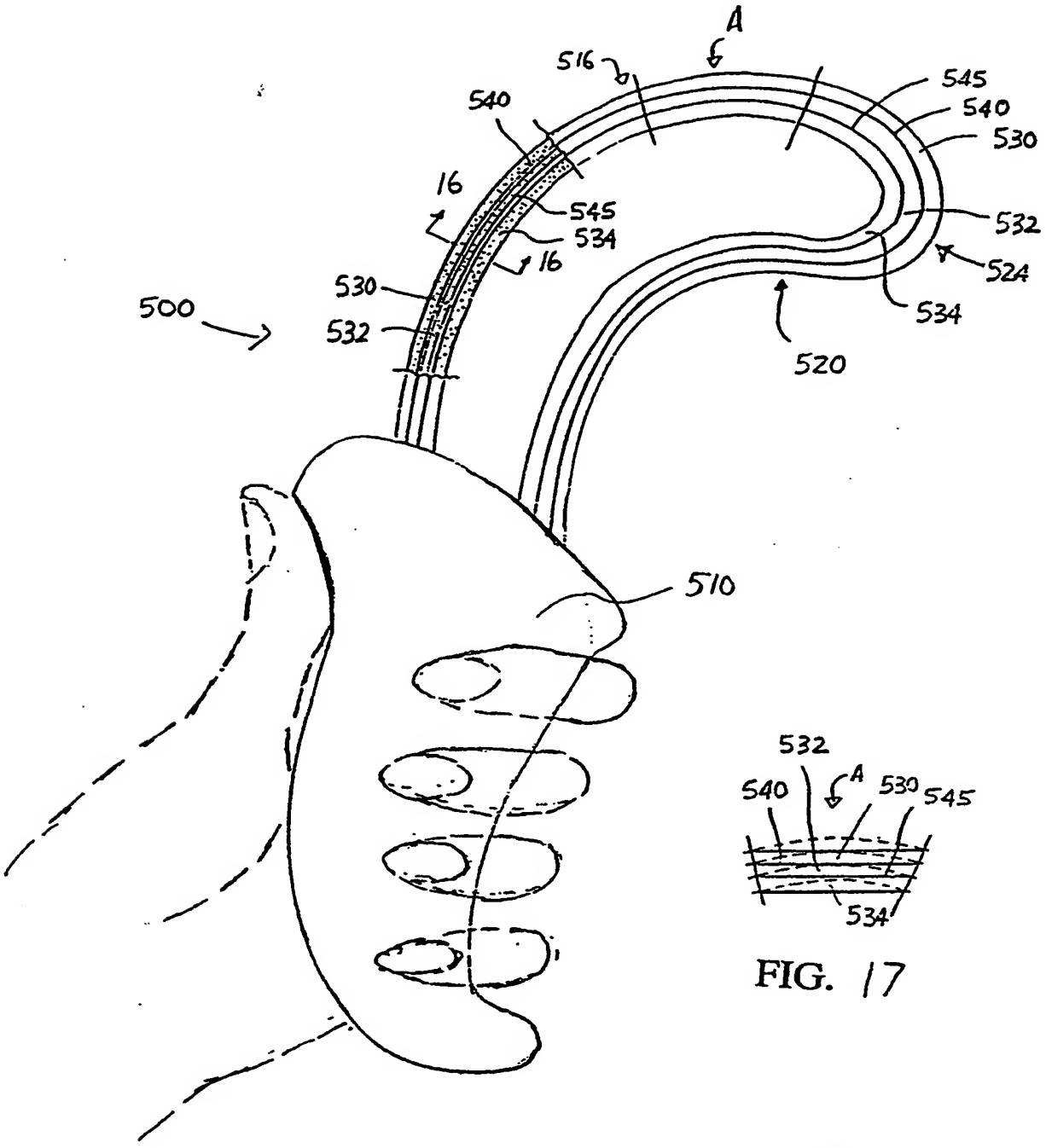


FIG. 15

FIG. 17

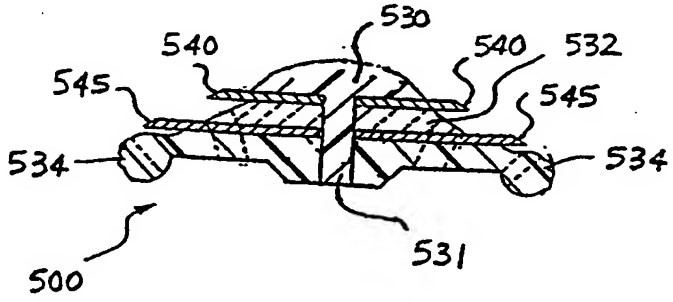


FIG. 16

FIG - 18

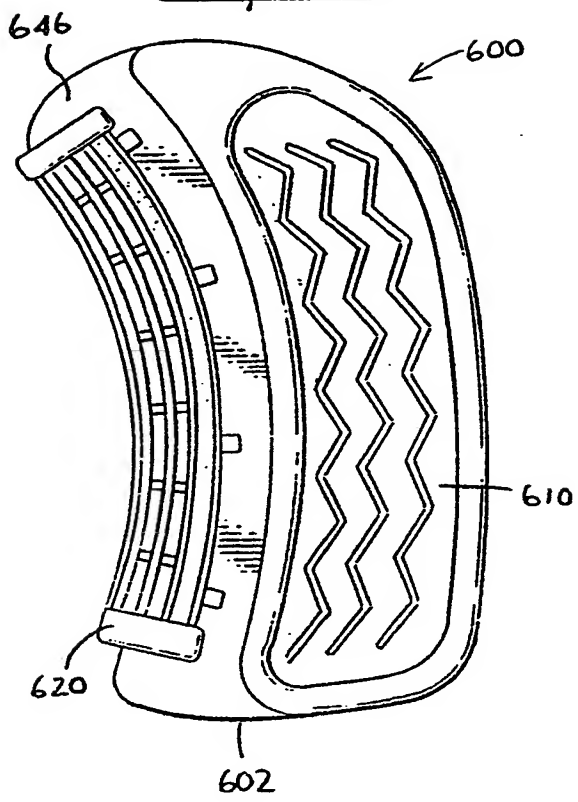
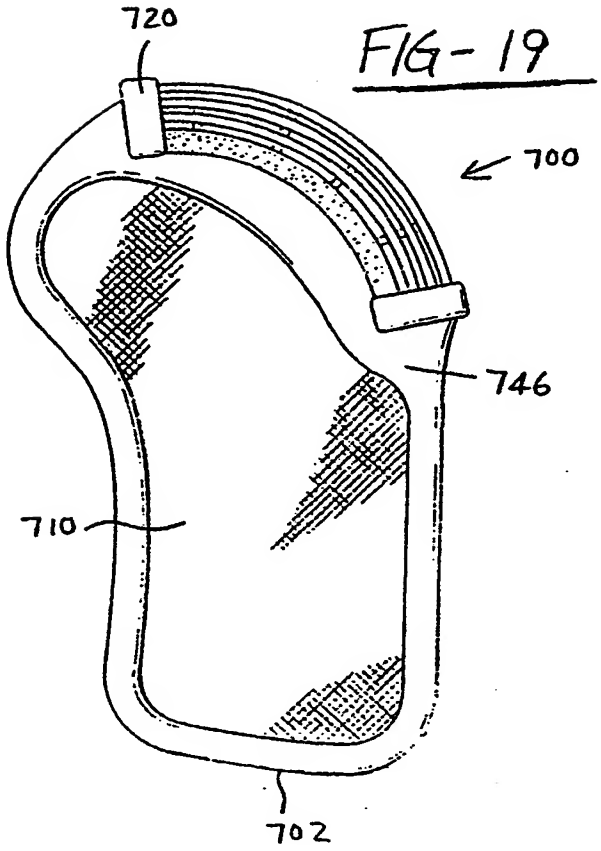


FIG - 19



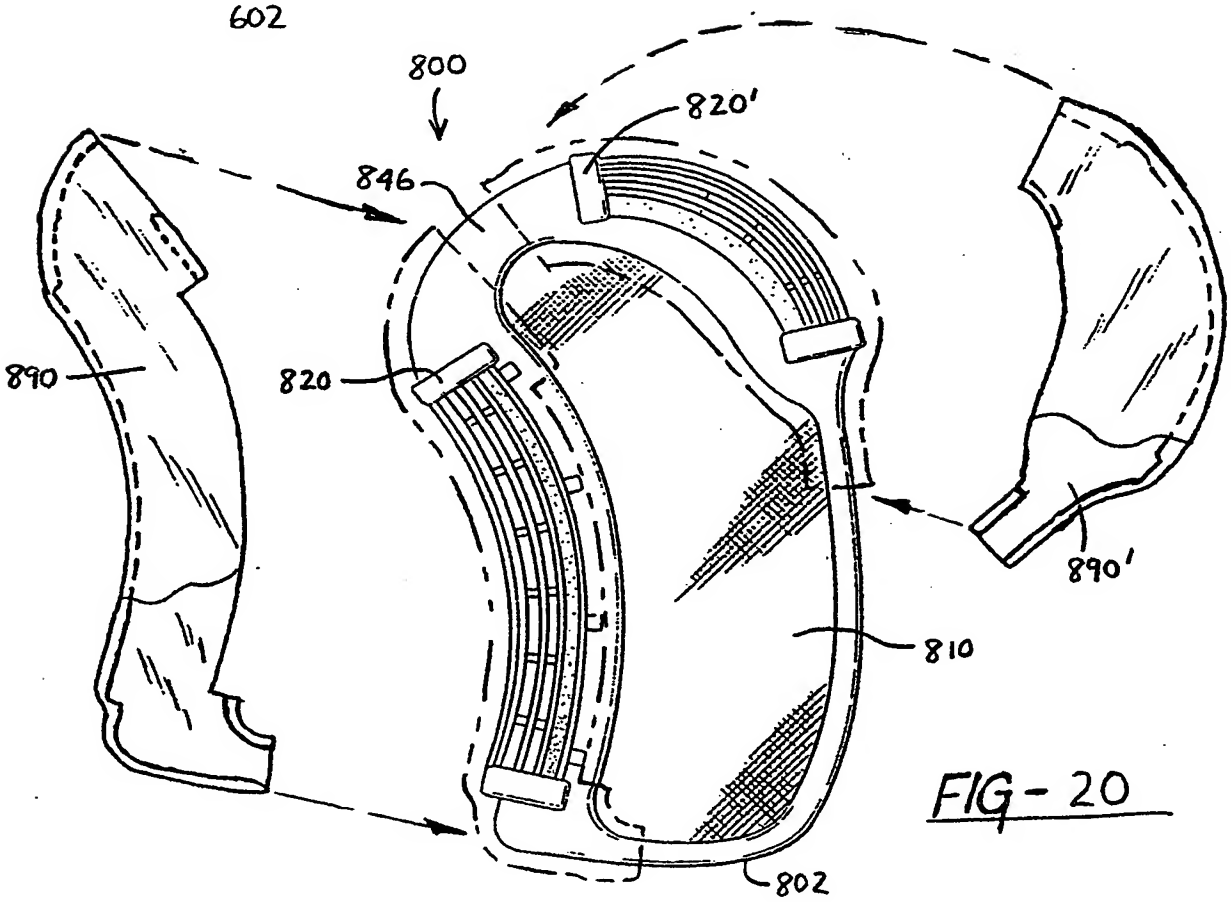


FIG - 20

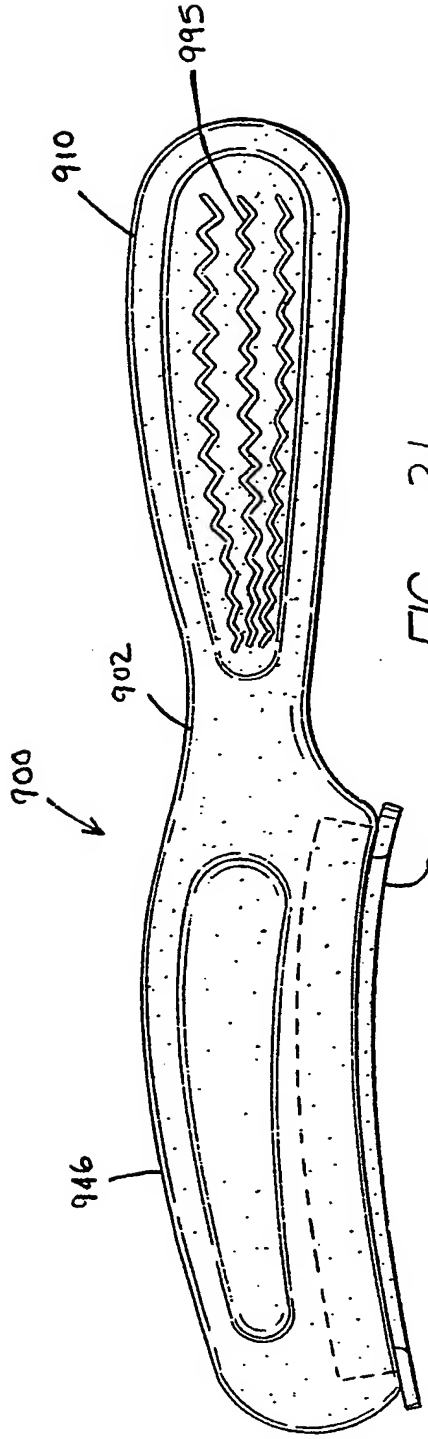


FIG - 21

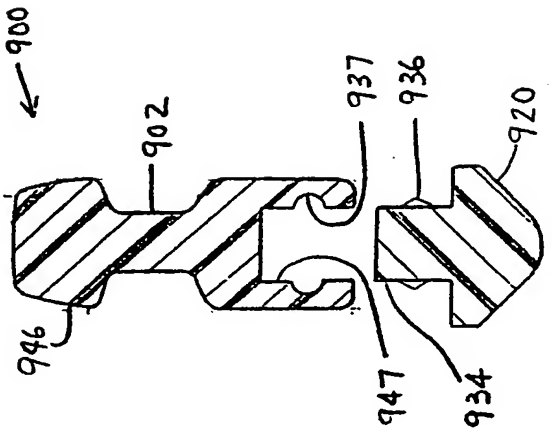


FIG - 23

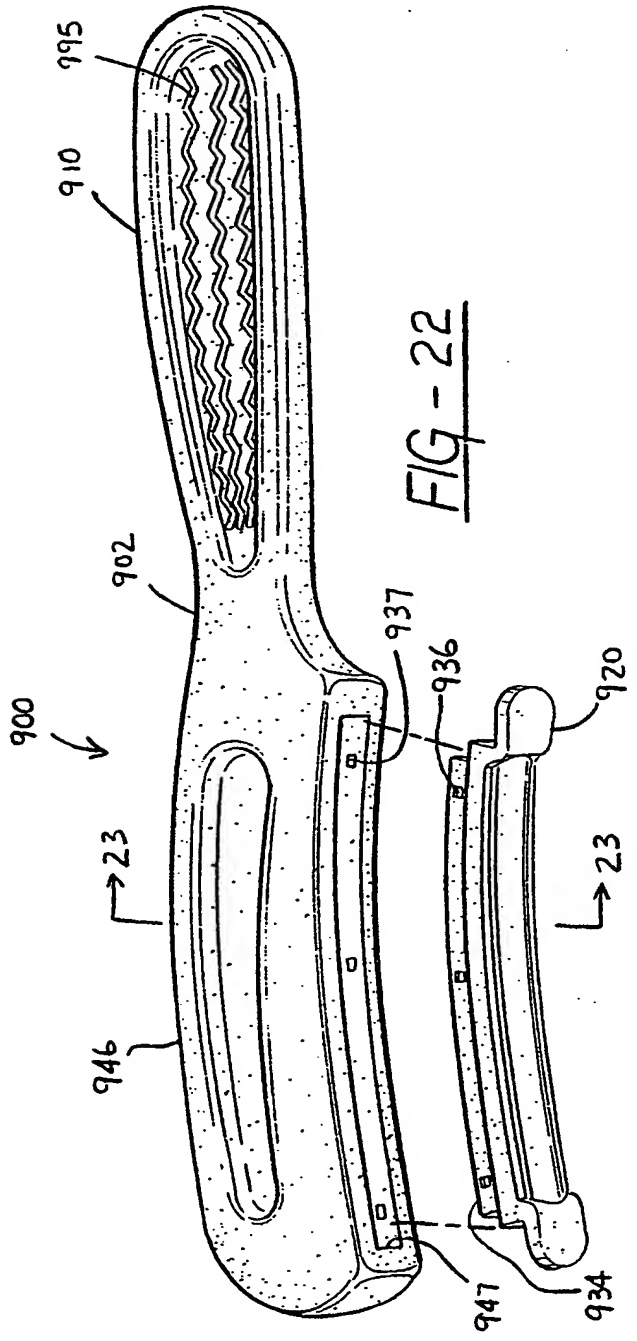


FIG - 22

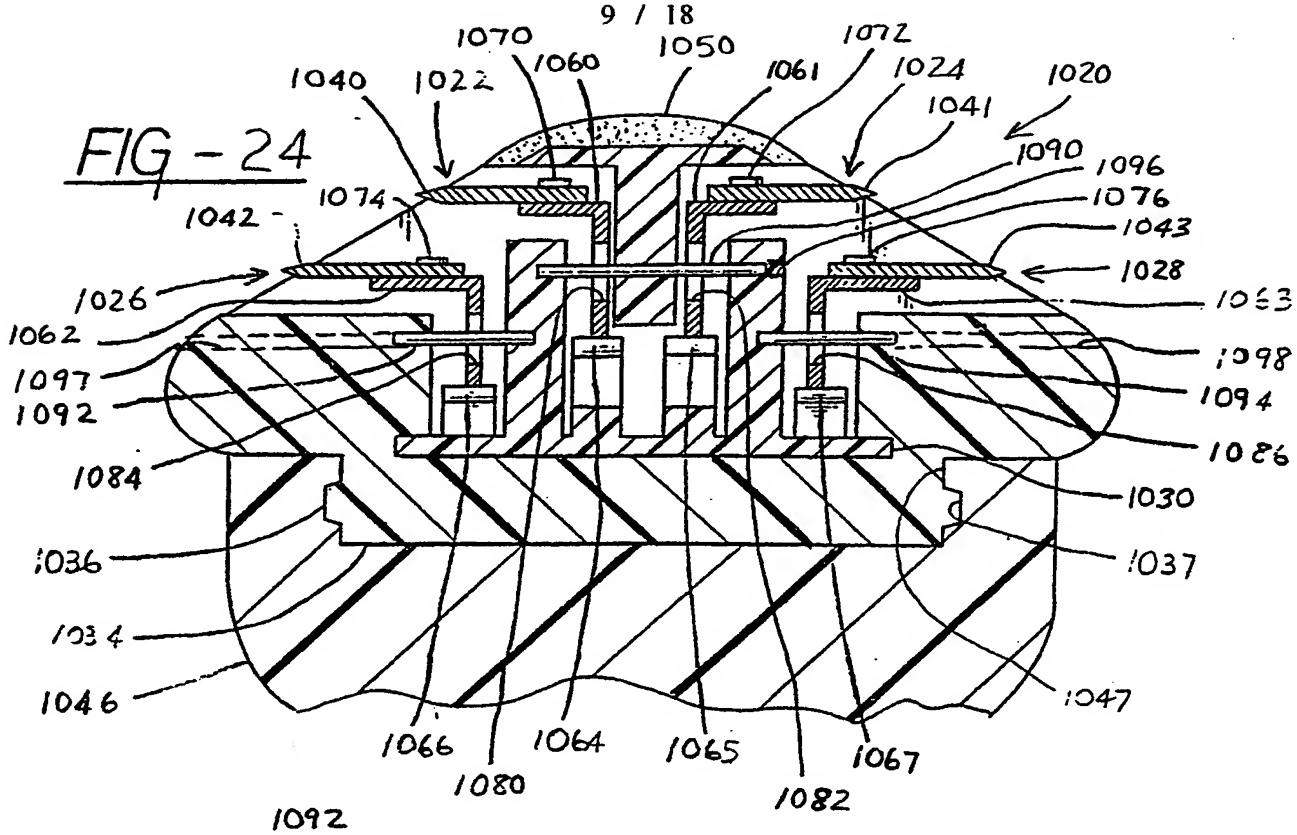


FIG - 24

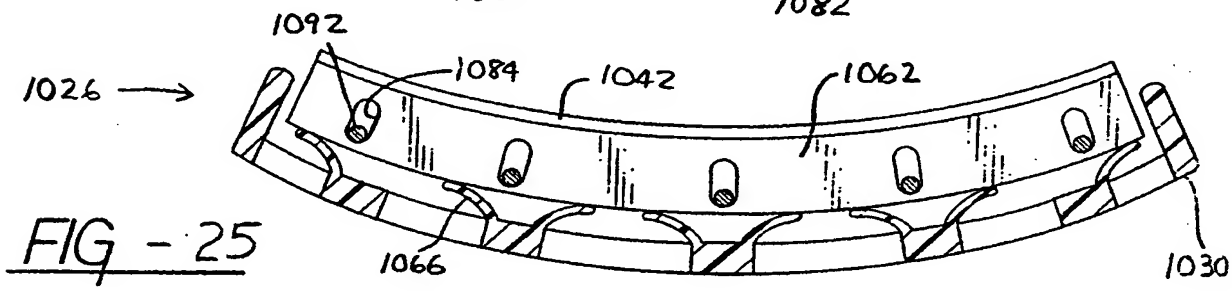


FIG - 25

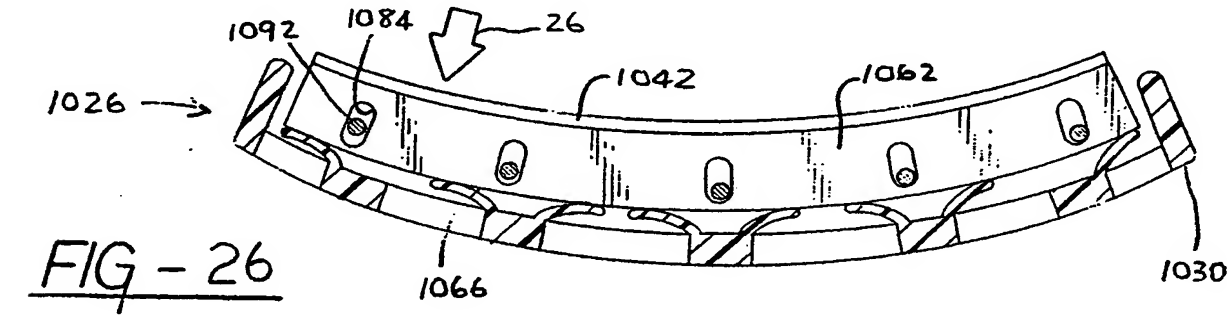


FIG - 26

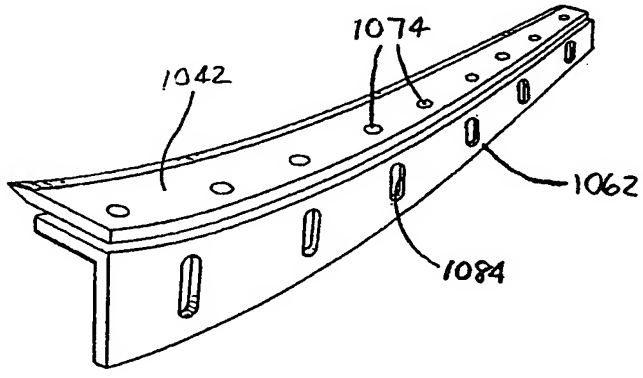


FIG - 27

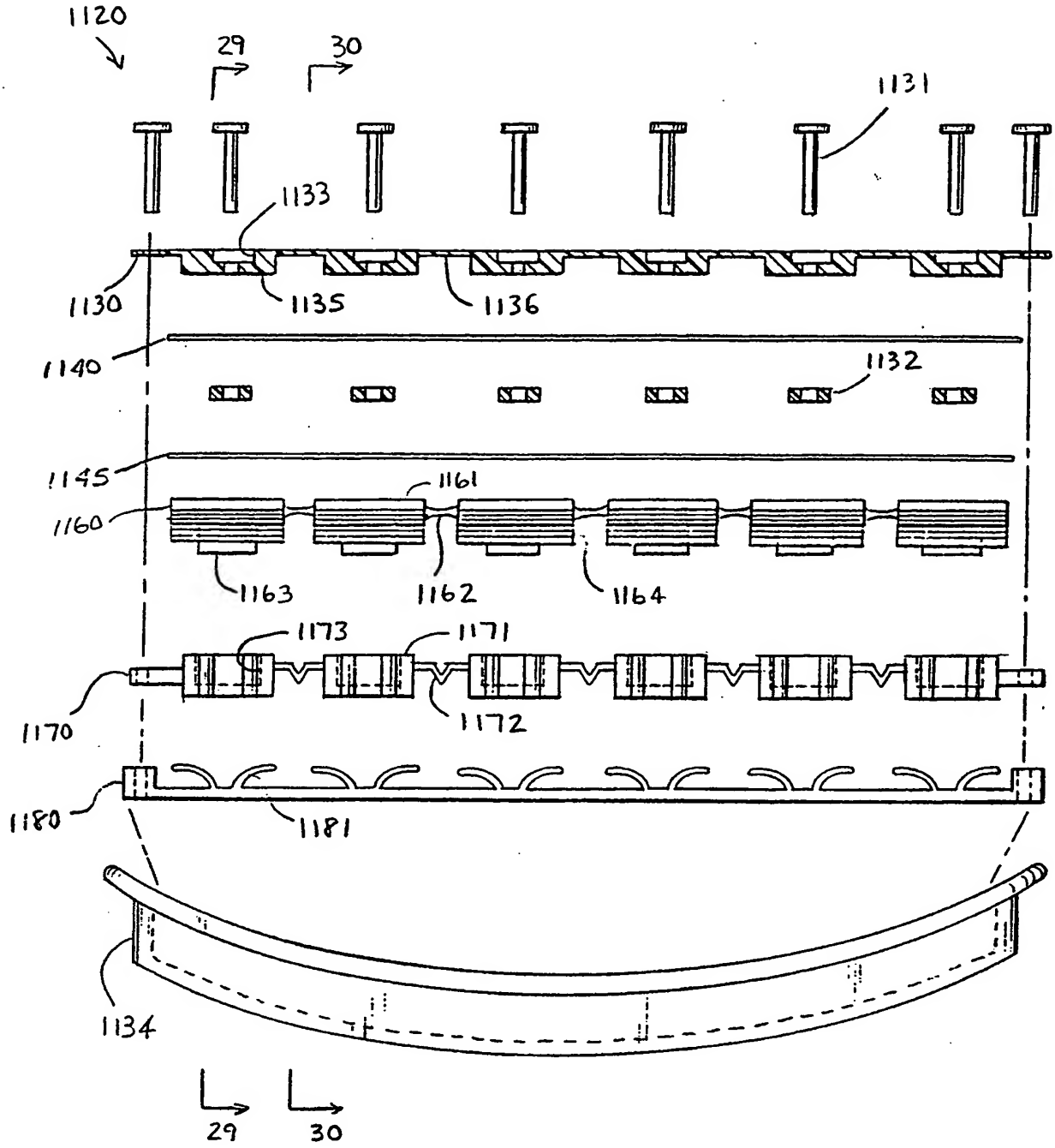


FIG - 28

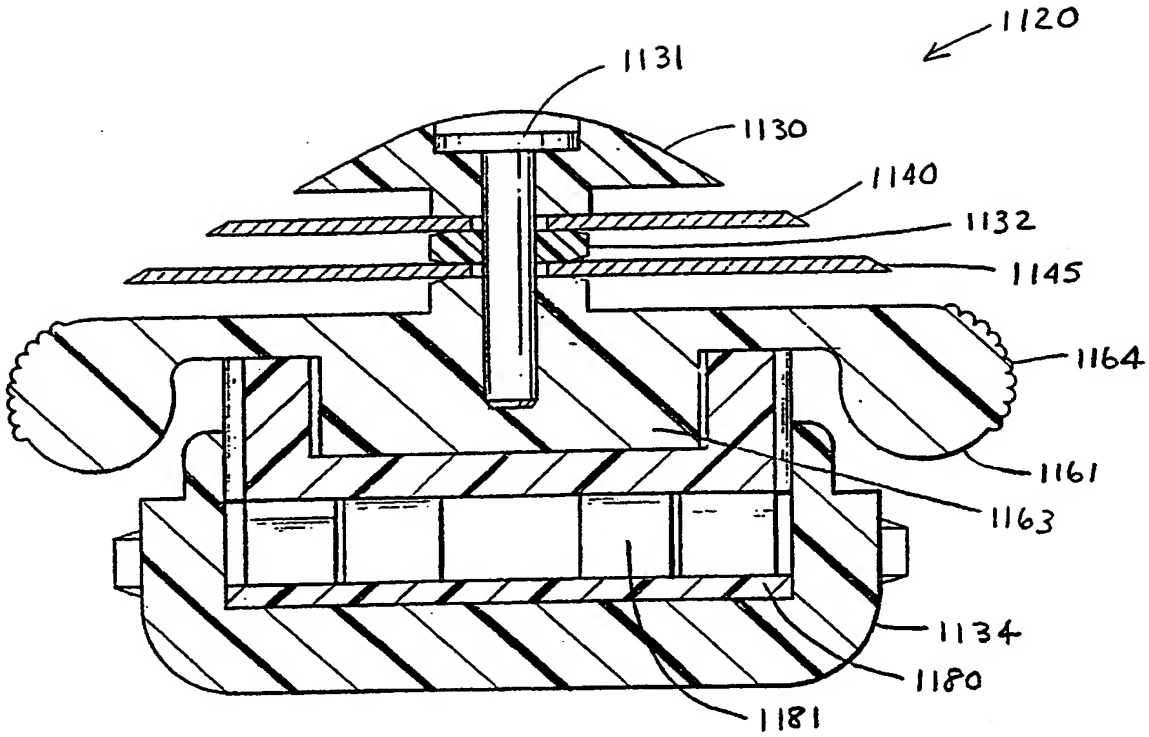


FIG - 29

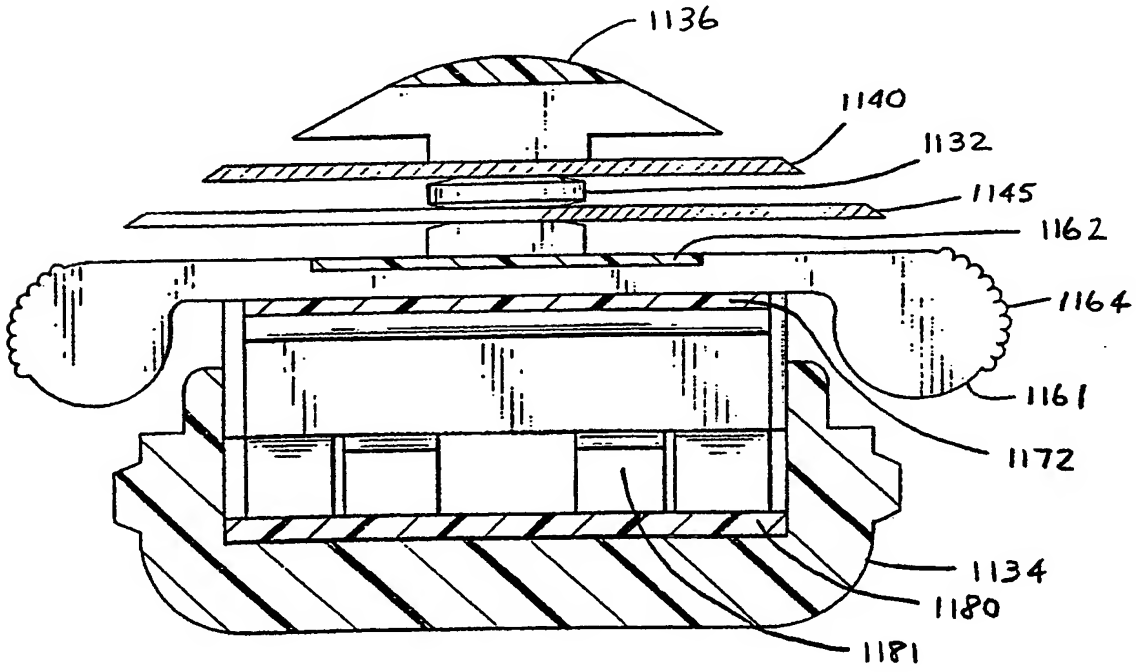


FIG - 30

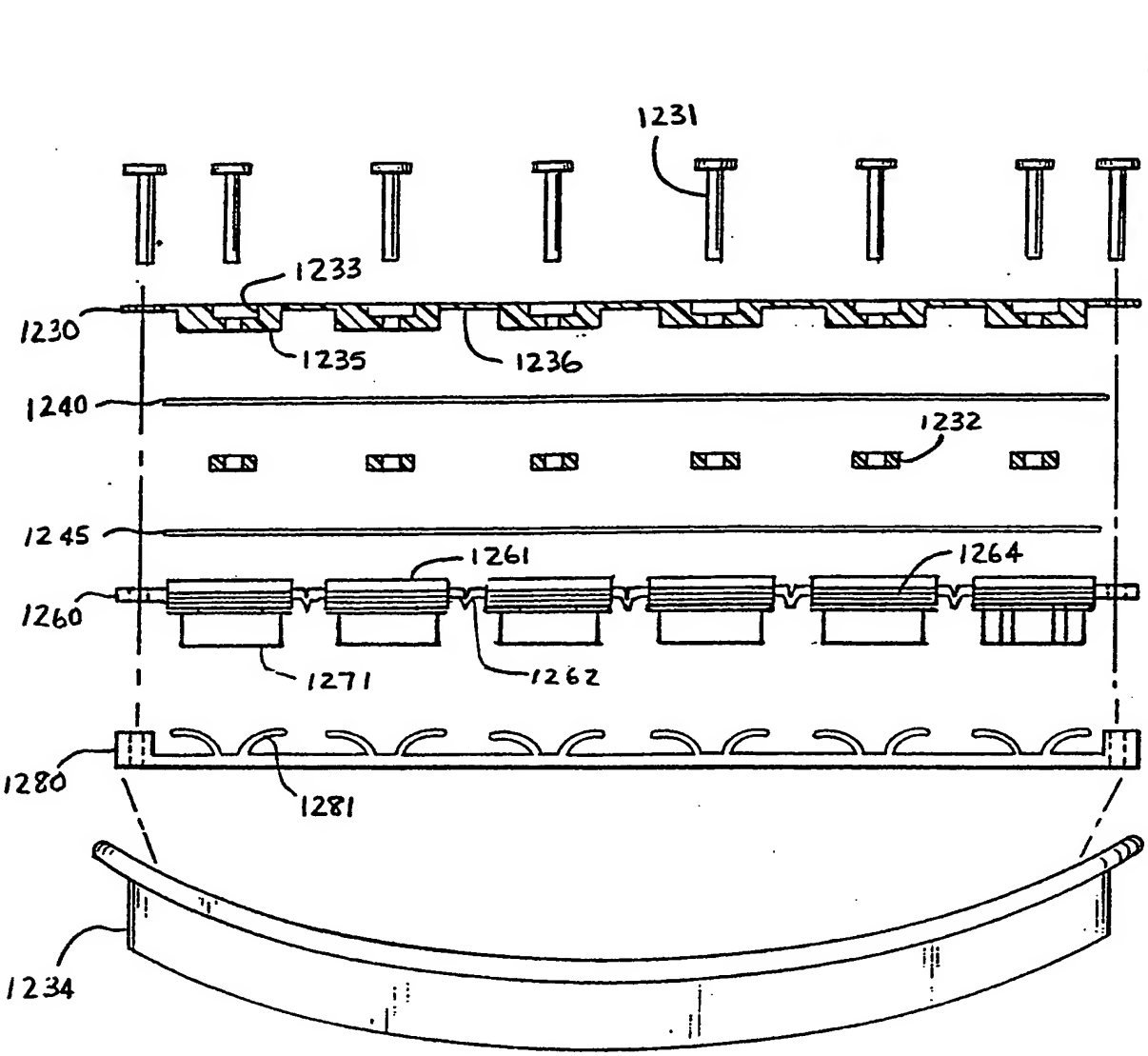


FIG - 31

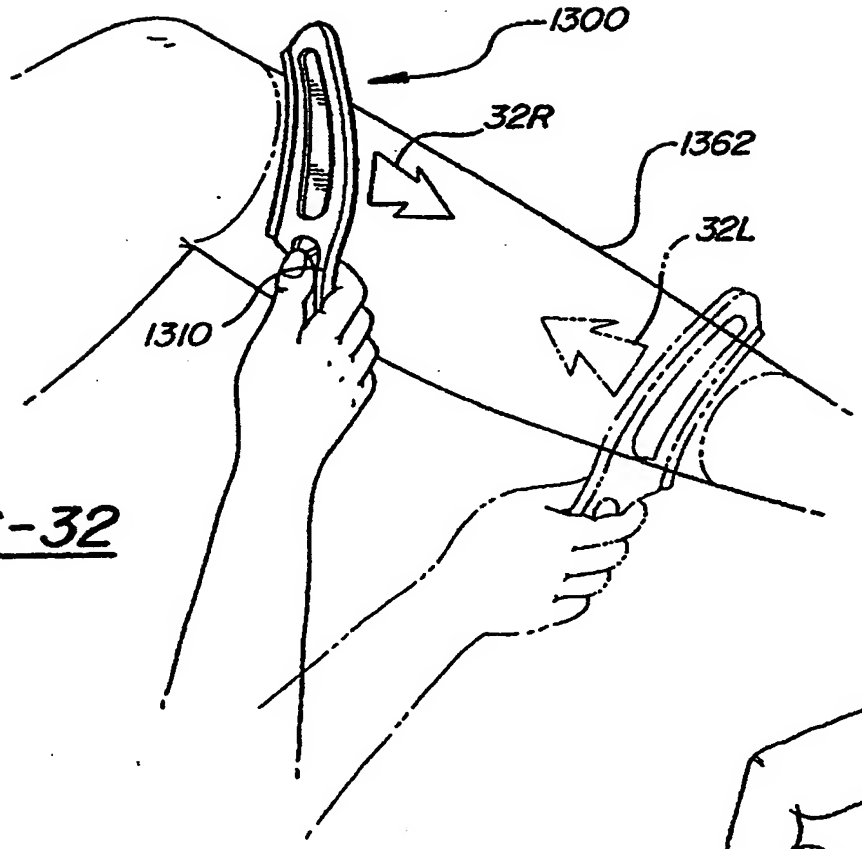


FIG-32

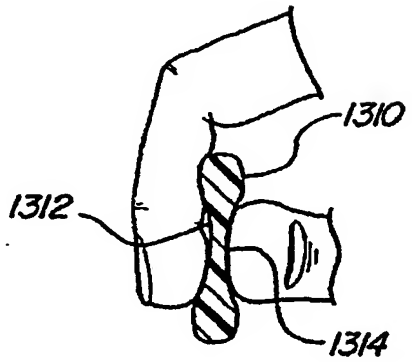


FIG-33

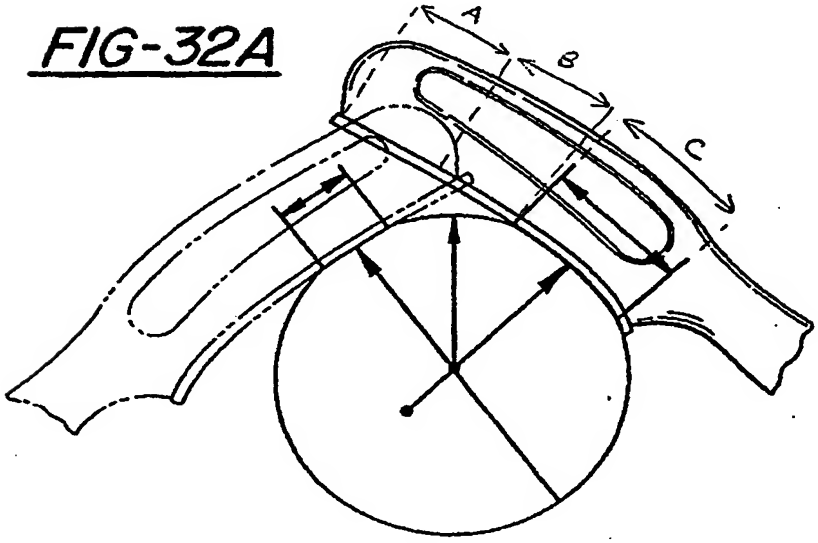


FIG-32A

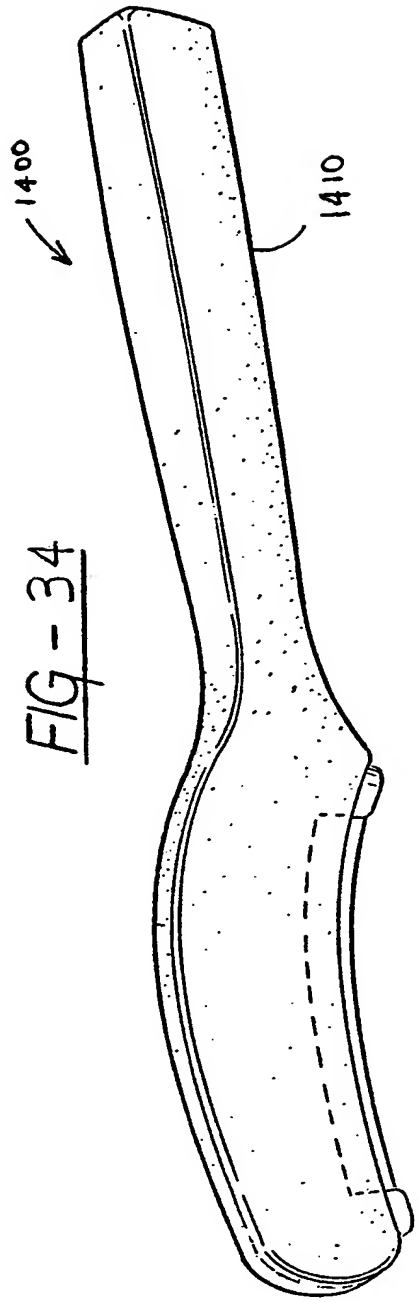


FIG - 34

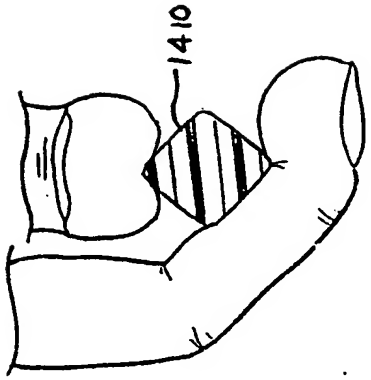


FIG - 37

FIG - 36

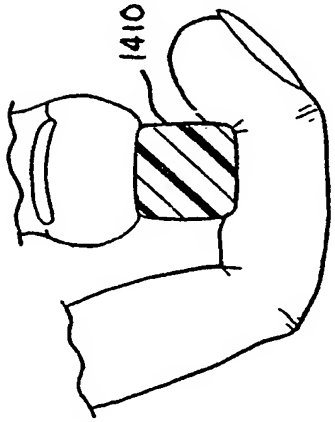


FIG - 35

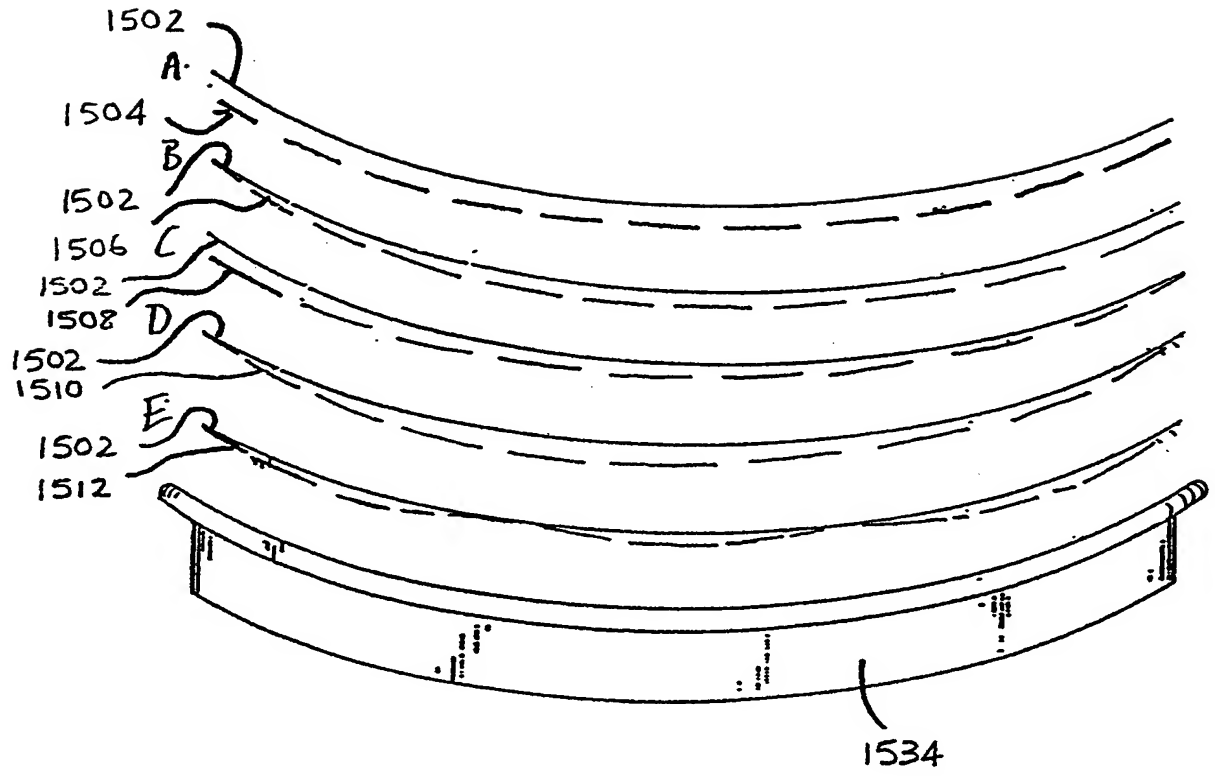


FIG - 38

FIG - 39

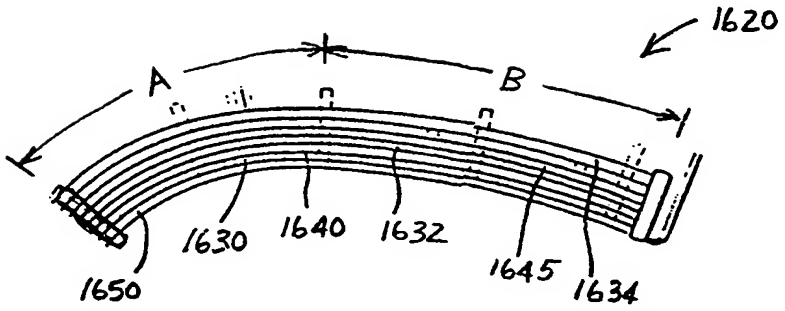


FIG - 40

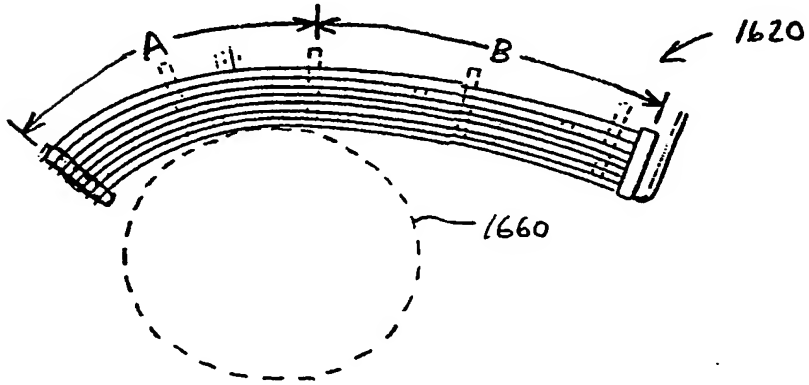


FIG - 41

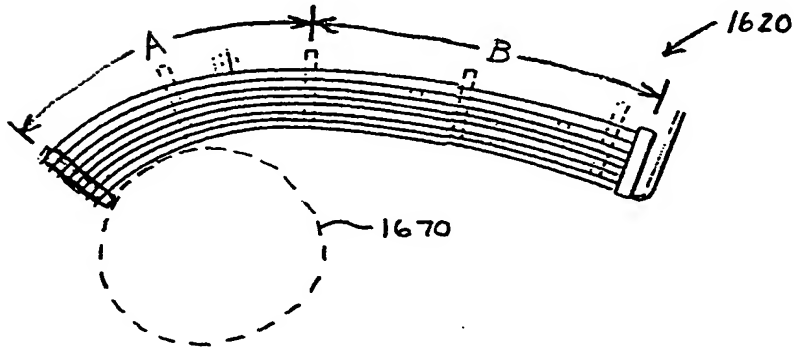
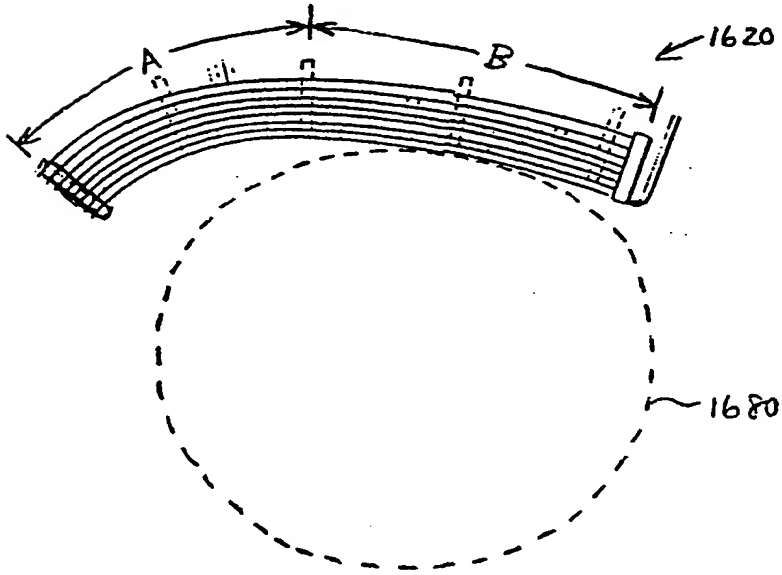


FIG - 42



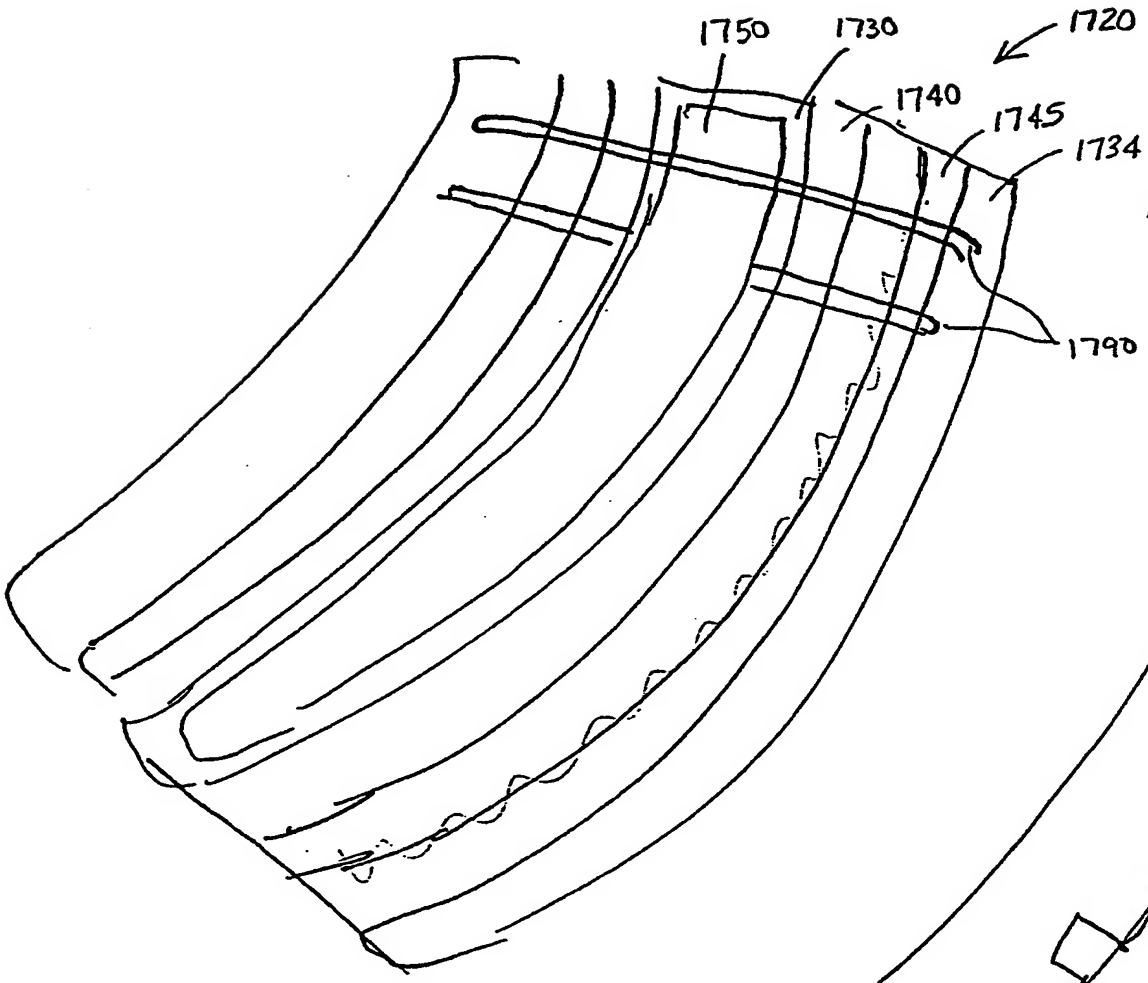


FIG. 43

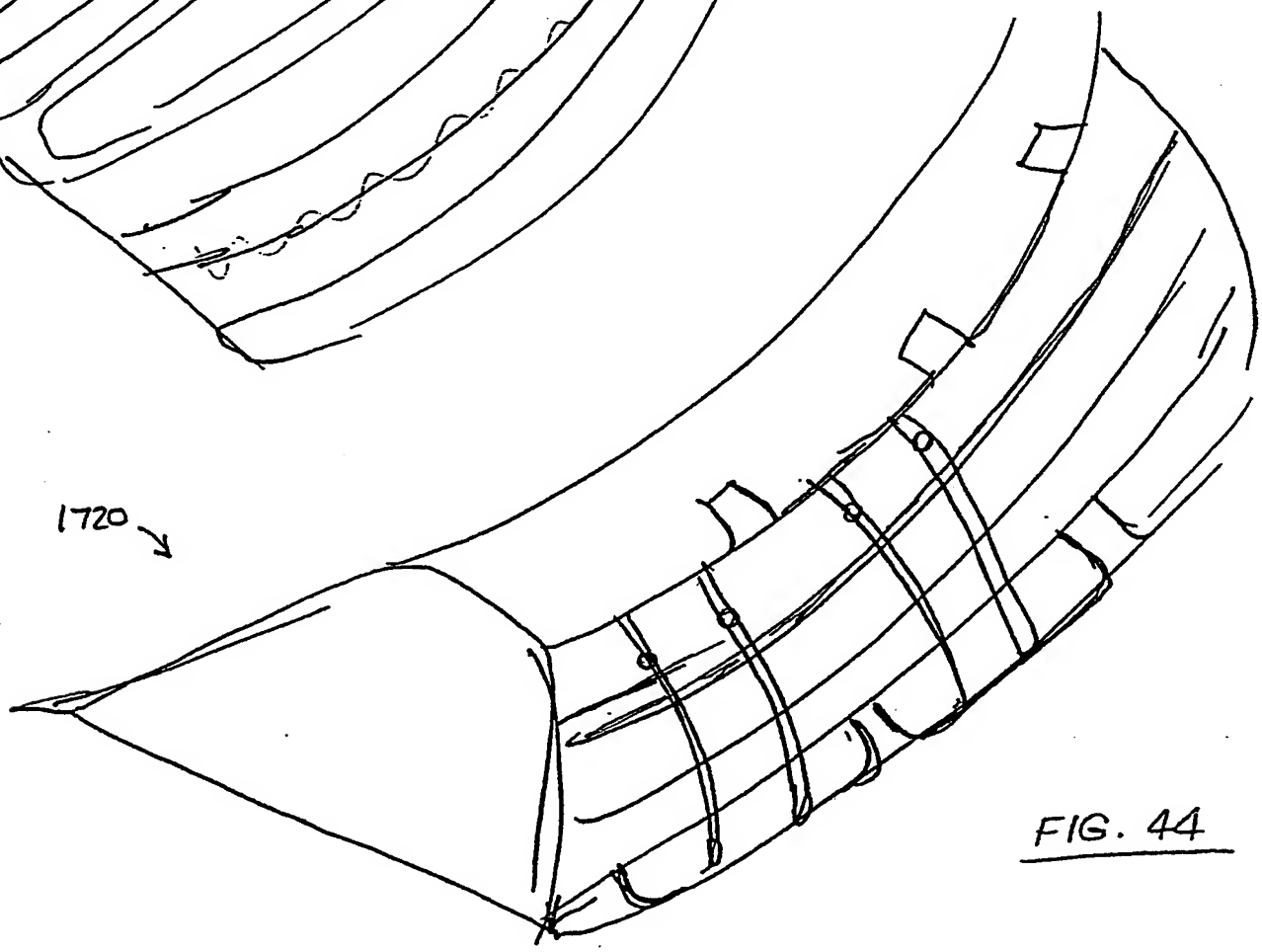
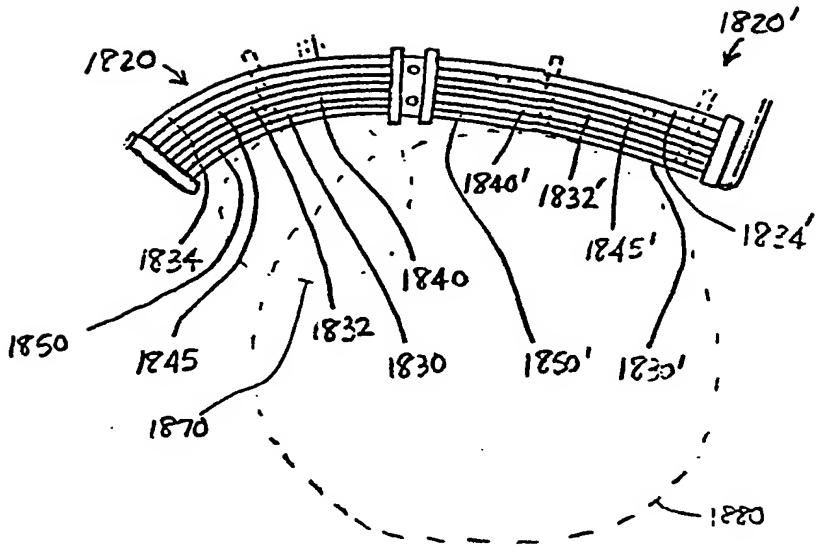


FIG. 44

FIG - 45



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(74) Agents: NOLAN, Robert, S. et al.; Harness, Dickey & Pierce, P.L.C., P.O. Box 828, Bloomfield Hills, MI 48303 (US).

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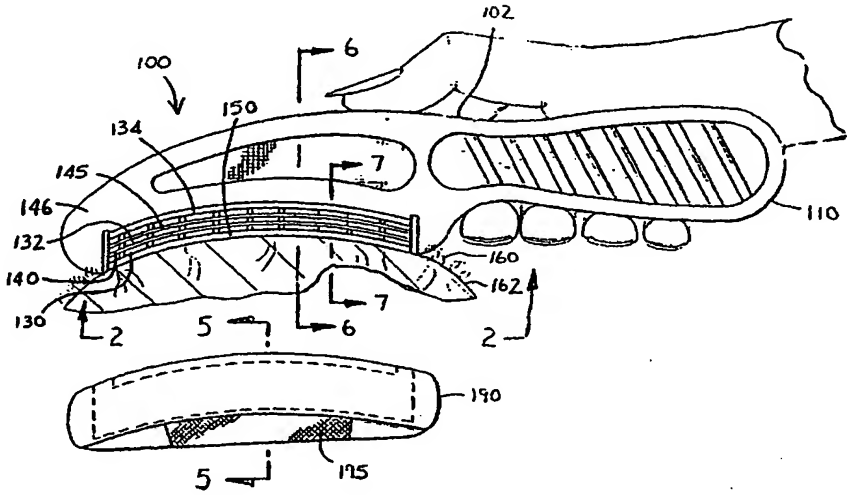
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: BODY SHAVING DEVICES WITH CURVED RAZOR BLADE STRIPS



(57) Abstract: The present invention disclosed manually operated, non-electric body shaving devices (100) for shaving substantially curved body portions as legs, arms and underam regions. These shaving devices (100) include a handle (110) and a curved razor blade structure (120) featuring one or two elongated razor blade strips (140, 145) held in a permanently curved configuration. The razor blade structure (120) typically includes a blade support platform (134), flexible razor blade strips (140, 145), and a blade cap structure (130) that holds the razor blade strips (140, 145) in a permanently curved state. The razor blade structure (120) is preferably longitudinally arranged on the handle (110), so all major components are located in-line for ease of use. Several embodiments of the body shaving devices having one or more substantially curved razor blade strips are shown and described, including bi-directional and flexible curved razor blade structures and in-line curved cartridge structures.

WO 01/34352 A3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/26322

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :B26B 21/56
US CL :30/49, 50, 51, 356

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 30/49, 50, 51, 53, 74.1, 346.5, 356

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,980,974 A (Radcliffe) 01 January 1991, Fig.4.	1, 2, 5, 7, 8, 11,13 and 21
Y	US 5,522,137 A (Andrews) 04 June 1996, Figs.23-27.	1, 2 ,5, 7, 8, 11, 13 and 21
E	US 5,979,056 A (Andrews) 09 November 1999, see Figs. 29-48.	1-27

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer HWEI-SIU C. PAYER Telephone No. (703) 308-1148 Sheila Veney Paralegal Specialist Technology Center 3700

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